CURRENT SCIENCE

Vol. VIII] April 1939 [No. 4

Zoological Survey of India

IN our Editorial of December 1935 attention was directed to some of the important activities of the Zoological Survey of India during the years 1932–35, and the hope was expressed "that the authorities while Indianising the services, will also provide them with the necessary means of maintaining their high standard of efficiency and traditional reputation". It is with sincere regret, therefore, that we find, in the triennial report of the Department for the years 1935–38, recently issued by the Director, that the curtailed activities of the Department, following retrenchment in civil expenditure in the year 1931–32, had not been materially restored even during the period covered by the last report. So long as there is no Committee of Scientific Advice, as envisaged by us in 1935, to educate our Legislators and Civilians, in whose hands lie the destinies of even the expert scientific services, it is perhaps useless to expect a fair deal for all scientific and similar activities. We do not blame the Governments for not providing funds for scientific investigations, but at the same time we are definitely of the opinion that, for want of a central organisation to co-ordinate scientific activities of the various services on a national basis, considerable portions of the funds already provided are not properly spent, with the result that there is duplication of work in some fields and starvation of legitimate activities in other spheres. In view of the uncertainties in the international situation and the rôle which science must play in the event of any war, is it not proper for the Governments of the country to devise ways for utilising to the best advantage the scientific resources of the country, both in men and material? In our opinion this can only be done by having a Board of Scientific Advice on the same lines as in Great Britain or some other countries.

The curtailment in the activities of the Zoological Survey was effected in 1931–32 on the advice of the General Purposes Sub-Committee of the Retrenchment Advisory Committee, which unfortunately did not include even a single scientist. The recommendation naturally, therefore, could not be based on a proper consideration of the importance of the activities of the Survey and other scientific departments.

To revert to the Zoological Survey of India, the activities of the Department as revealed in its two reports, seen by us and covered by a period of six very lean years of its working, leave no doubt that there is a considerable difference in the functions of the zoological departments of the universities and the Zoological Survey of India. For instance, during the period under report, the Zoological Survey of India, in addition to attending to the needs of the Indian Museum and to innumerable minor enquiries of various types, carried out detailed investigations in connection with (*i*) shell fisheries in the Andamans and their economic exploitation; (*ii*) biological investigations at Pulta near Calcutta in connection with the water supply of Calcutta, and at Senchal lakes in connection with the water supply of Darjeeling; (*iii*) special enquiries regarding the rôle of indigenous species of fishes as larvivorous forms in connection with anti-malaria measures; (*iv*) identification of animals of economic importance from the medical or sanitary point of view for various scientific institutions; and (*v*) identification of human and animal remains excavated by the Archæological Survey and other bodies at various prehistoric sites in different parts of India.

The work on the Shell Fisheries in the Andamans was of direct economic importance. The Department was able to establish that the two common types of shell of *Trochus* represented only plastic phases of the widely distributed Indo-Pacific species *Trochus niloticus* Linn. The rate of growth, age at which maturity is attained and the longevity of the species have been worked out. From the survey of the fishing beds it has been ascertained that shell fishing has been carried on to such an extent as to have endangered all commercial possibilities of regular fisheries, and in accordance with the knowledge gained regarding the bionomics of the species an entire stoppage of fishing for a period of three years was suggested to the Andaman and Nicobar authorities.

The biological investigations at the Pulta Water Works also had a very important economic aspect in so far as certain organisms were found to interfere with the proper working of the slow-sand filters. Besides determining the seasonal variation in the fauna of the Settling Tanks, Filter-Beds, etc., the Department found that these variations in the animal populations could be co-related with the presence or absence of aquatic vegetation, the quantity of silt held in suspension and the salinity of water. Several remedial measures were suggested by the Zoological Survey of India, which the Corporation of Calcutta adopted with considerable advantage to the working of the filter-beds. The Department's activities in this connection are stated to have now reached a stage when the data collected and the opinions formed should be tested experimentally in order to devise permanent measures of relief.

It is indeed a great pity that owing to lack of funds the survey activities of the Department had to be greatly restricted. Our knowledge of the geographical zoology of

India is very meagre indeed and when the Zoological Survey of India was established in 1916 one of the functions assigned to it was to collect data about the zoogeography of India. Special mention may, however, be made in this connection to the preliminary survey, during the period under review, of the Santal Parganas, where certain species of fish hitherto unknown from the Eastern Himalayas were found; these have thrown considerable light on the palæogeographical features of the country.

In spite of severe handicaps under which the Department is labouring, the Departmental publications have been kept up-to-date and at an acknowledged high standard. The staff has also published numerous original articles, some of which are of unusual interest and of great merit. The laboratories of the Department, as in previous years, continued to attract a large number of workers from different parts of India and abroad. It is perhaps not generally realised that for zoological research the laboratories of the Zoological Survey of India provide unique opportunities in the East, not only on account of its extensive library, the magnitude and variety of its research collections, and, last but not the least, the expert knowledge of its staff which is available for all research workers.

The improvement effected by the Department in the Public Zoological Galleries of the Indian Museum is evident from the illustrations of some of the exhibits reproduced on three halftone plates that accompany the report. A start has been made by the Department to make the exhibits popular and attractive for the general public. Special mention may be made of the fact that purely scientific labels have been replaced by popular labels in the recently arranged galleries, and in the case of the Fish Gallery labels in Bengali also have been installed.

The details of the activity of the Department can be judged from a perusal of the Appendices A to J, which accompany the report. They contain information regarding the specimens sent to specialists for study or identification; the list of new types and co-types added to the collections; the list of donors; the list of new exhibits in the public galleries; the specimens received for study or identification; the list of Zoologists, Anthropologists, etc., who made use of the Library and Laboratories; the list of publications, official and unofficial; and the additions to the Library.

It is with considerable pride and pleasure that we have commented on the useful work done by the only thoroughly Indianised scientific department of the country. Not very long ago it was openly said that Indians were not scientifically minded, but we are definitely of the opinion that this was based on erroneous assumptions, as very few, if any, opportunities had then been available to Indians for showing their scientific worth. Even now where chance or accident has placed them in suitable positions to carry on scientific work the authorities are not really helpful, as the grants sanctioned in the way of emoluments for their staffs and for the works of the departments are hardly sufficient even to keep them on a maintenance basis, much less to carry on detailed surveys or research work. May we wish and hope with the Director that the work of the Department will be restored to its normal pre-retrenchment level before very long, and that adequate use will be made of its staff in the much-needed economic development of the country.

Applied Research and The Indian Institute of Science, Bangalore*

IT is recognised that the principal objects of the Institute are three-fold, namely, (1) Technological Instruction, (2) Research in Pure Science, and (3) Research in Applied Science. The first two objects are receiving attention to a reasonable extent but the facilities available for achieving the third object have been neither adequate nor clearly specified.

I am giving prominence to applied research because this is an industrial age and production of primary products is comparatively far less profitable than products of industries and manufactures. If you continue importing products of manufacture which the people of this country can produce for themselves, you will not only be paying for them from your slender income in uneconomical occupations, but you will also be increasing unemployment at the same time.

It is unnecessary at this stage to enter into any discussion whether this Institute should give greater attention to research in Pure Science or Applied Science. Both are necessary. Theoretical research is the basis, but it should be linked up and correlated with applied research. If, in some foreign institutions, pure research is given prominence it is because they have their surfeit of industrial income and those countries can afford it. Even there in cases in which the outlay is small as here, more attention is given to practical than to theoretical research. If regard be had to the small sums we are spending, it is incumbent on us to spend a greater portion on practical research than we do at present. A distinguished scientist connected with the General Motors Corporation, Mr. C. F. Kettering, has remarked: 'A development is no good so long as it is in the laboratory. It is only good when everybody in the country uses it.'

A large amount of fundamental research is being done in Europe and America, the results of which may be examined with an eye to their adaptation to local conditions and application to local uses. Pamphlets may be written and articles published in technical journals to spread the result achieved abroad among industrialists and research workers in this country. The professors in the Japanese Universities, within my own observation, are very good at this kind of work. They vie with one another in giving the earliest possible information of foreign discoveries and inventions to their countrymen.

This Institute being an all-India concern, a Bureau for collection of information of value to practical research and to industries should, in my view, be created as one of its independent departments. ..... Notes, files and books giving the latest particulars and state of advance should be maintained in the Institute Library. Business men would themselves come or would send their representatives here to seek information and knowledge, and the service rendered to industries by this means would be of the maximum value for a minimum outlay.

An officer who has knowledge of the working of industries should be attached to the new Information Bureau just suggested by me. He should be able to compile the information required for each branch of industry in collaboration with the professor of the branch of science concerned.

Another point to be borne in mind in this connection is that, in the case of research in applied science in foreign countries, the results of practical value are usually revealed in general terms, while the actual processes which are of commercial value are kept secret. In such cases, secondary research may be profitably carried on with advantage in this Institute to discover such secrets earlier than they are revealed so as to put the results to practical use.

If it gets a reputation for service to industries and industrialists in these matters, the Institute will surely be able to obtain additional funds to extend its scale of working. It is on record that in Great Britain quite recently the research associations increased their resources by 30 per cent. in

* From the Address delivered by Sir M. Visvesvaraya, President of the Court of the Indian Institute of Science, Bangalore, at the meeting of the Court held on March 25, 1939.

two years by working in closer association with industrial firms in this way.

In regard to most of the work I have mentioned, a beginning can be made if the Professors, Assistant Professors and Readers are all of one mind in the matter of encouraging industrial research and making themselves useful to industries. If they are able to meet and discuss the needs of the industries, if all the departments can work in unison for a few months in succession, and if each Professor undertakes some work in applied research in one or two industries, they will soon be beginning to achieve practical results even without requisitioning additional equipment and facilities from the Council. Any such voluntary effort on their part will have a tremendous moral effect, both on the controlling authorities and the industrially minded public. And there will be no dearth thereafter of funds or staff for continuing the work.

The principal measures to this end which suggest themselves to me are:—(1) To get into touch with industries and industrialists and ask what work they want to be done for them at the Institute, and to consider how much of it, it is reasonable to provide for, what part of it, if any, is done at present and what additional funds and facilities are necessary to do the remainder—in other words to work on a plan, (2) To endeavour to set apart from the resources of the Institute, staff, equipment and funds to be specifically devoted to industrial research in future, (3) To announce after careful investigation what information and data the Institute can supply or collect for industrial firms and corporations from outside centres by charging a fee for the purpose, (4) To find out how many industries are willing to employ research workers under the supervision of Professors to work out their problems in applied research.

The country is undeveloped. The unemployment problem is staring us in the face. The resources of the Institute are meagre and the Irvine Committee too has expressed the opinion that concentration on industries and on work of a practical character is our sorest need to-day. At such a time, theoretical research should not be pursued to the extreme extent of overshadowing all work of practical value. It is for this reason that I have suggested that at least half the resources of the Institute and half the time of the staff should be set apart to those branches of applied science that have a bearing on practical pursuits and the income-earning professions of the people.

Some people would like all objects of material gain to be eschewed and the Institute made to do its work in a purely cultural and scientific atmosphere. Have that atmosphere as thick as you like where you can afford it, but in the present circumstances, the country's prime wants—its basic needs —should be the first concern of the Institute. Industries are needed to give work for the unemployed and relief to the distressed. And applied research, which the Institute can do much to encourage, may be regarded as the mother of industries.

The expectation of the public is that the Institute should actively help in the direction of developing industries, training industrially minded young men and creating an industrial atmosphere in the country to promote production and income and raise the standard of living of our people. If this great change be effected, we may then with confidence appeal for larger contributions from Provinces, States and business public generally. But if the Institute remains content with pure science and the creation of a scientific atmosphere, when the tragedy of an illiterate, under-nourished population is being enacted before our eyes, we will not be doing our duty in the spirit of the wishes and ideals of the eminent founder of the Institute. I think, therefore, we must now unhesitatingly revise our notions about practical research, its influence on the country's progress and its place in the scheme of work of this Institute. In the words of the Irvine Committee, we must 'make applied research the first and most responsible duty of the Institute'.

A Preliminary Note on the Catastrophic Chilean Earthquake of January 25, 1939

By S. R. Savur and S. M. Mukherji
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THE great circum-Pacific seismic belt which passes through Chile began to exhibit unusual activity in November last and there occurred about half a dozen large or very large earthquakes in the Pacific, to the east of Japan and to the South of Alaska. The disastrous Chilean earthquake of January 25, 1939, appears to be the last of this series and is no doubt, the most catastrophic (in point of destruction of human life and property) of all the earthquakes that have occurred since the Quetta earthquake of the 30th May 1935.

Seismological data for the Chilean earthquake have so far been received here from Kew, Neuchatel, Basel, Zurich, Chur, Stuttgart, Hamburg, Perth, Riverview, Cape Town, Hongkong, Dehra Dun, Hyderabad, Agra and Calcutta. The original seismograms from the last three stations are also available. Except Kew and Cape Town all the stations have recorded the first movement as emergent, while Kew, Zurich, Chur and Hamburg report eP_1' in addition to P. An analysis of the P and P_1' residuals using Gutenberg and Richter's tables[1] show that these data are in satisfactory agreement with the epicentre 36°·3 S. and 72°·2 W. This is about 20 miles to the north of Chillan. The time of origin of the shock is obtained as $25^d\ 3^h\ 32^m\ 12^s$ G.M.T.

Focal Depth

The problem of the depth of focus of the shock appears to present some difficulty. In the opinion of some,[2] the shock was of normal focal depth but Kew estimates the depth at about 75 km. In the Bombay E component a clear phase is recorded 18 secs. after eP_1'. If this be taken as pP'_1 a value of about 60 km. is obtained for the depth. The phase corresponding to 18 secs. is also clear in the Agra E component. Other clear phases, which are identifiable in all the seismograms from Agra, Bombay, Calcutta and Hyderabad, have been recorded at 28–31 secs. and 45–47 secs. respectively from the beginning. Assuming these to be pP' and sP' respectively, a value of 100 km. for the depth is obtained from each of these phases. Therefore these appear to suggest a depth between 60 and 100 km.

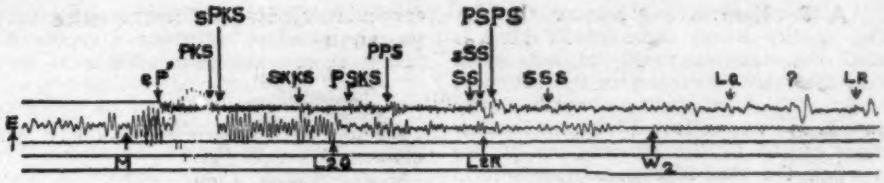
Another phase, namely, SKKS, is exceptionally clear in the Agra and Bombay records and is fairly so in the Calcutta and Hyderabad seismograms. Comparing the observed travel times of SKS and SKKS with Jeffrey's calculated times[3] we get the following values for the depth. Kew: SKS—50 km. and a sSKS (assumed here as SKKS)—50 km.; Neuchatel SKS—50 km.; SKKS at Agra, Bombay, Calcutta and Hyderabad—70, 60, 40 and 50 km. respectively. The mean of these values is 55 km.

We can also examine the question of the depth of focus from the macroseismic data, for, the focal depth of a shock is related to the radius of the area shaken by it and its maximum intensity. From the available data, Gassmann's formula gives 46 km. while Blake's formula 58 km. for the focal depth of this earthquake. The degree of reliability of the results obtained from Gassmann and Blake's empirical relations can be gauged from the fact that they give 12 and 6 km. respectively for the depth of focus of the Quetta earthquake (May 1935) while seismological evidences from a recent study of this shock made at Colaba pointed to a depth definitely less than 10 km. It thus appears probable that the depth of the Chilean earthquake was near about 60 km.

Energy

From the horizontal maximum amplitudes of the ground as recorded at C. Town (N,E), Kew (N,E), Bombay (N,E), Hyderabad (N,E), Hongkong (N,E), Agra (E) and Calcutta (N) we get 7·5 as the mean value of the magnitude of this shock which gives 10^{22} ergs as the lower limit of its energy.[4] In the case of the Quetta earthquake the lower limit was found to be 10^{21} ergs. Thus the energy of the Chilean earthquake, as manifested on the surface, was 10 times as great as that of the Quetta earthquake. Fortunately for the survivors, however, the former occurred at an abnormal depth. Had it been as shallow as the Quetta earthquake it would have produced much greater destruction which might have equalled that

[1] *Gerl. Beitr. Geophys.*, 1934, **43**, 82; *M.N.R.A.S., Geophys. Suppl.*, 1938, **4**, 370.
[2] *Nature*, 1939, **143**, 230
[3] *Publ. Bur. Centr. Seimol. Int.*, A. 14.
[4] *Gerl. Beitr. Geophys.*, 1936, **47**, 122–24.



Seismogram of the Chilean earthquake of January 25, 1939, recorded at Bombay
Δ = 144·7 Milne-Shaw, E.–W.

caused by some of the severest earthquakes of the world.

The E–W component of the seismogram of this earthquake as recorded at Bombay is reproduced above. The various phases that have been recognised have been marked on it. L_Q and L_R refer to Love and Rayleigh waves respectively. These have also been well recorded at most of the stations for which data are available.

On *Coeloplana* sp. discovered by Prof. W. M. Tattersall at Krusadai Island, Marine Biological Station, Gulf of Manaar*

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1. Introduction

THE genus *Cœloplana* was constituted by Kowalevsky, a Russian Naturalist, for a form he discovered in the Red Sea near the City of Tor in 1880, apparently because it combined cœlenterate and planarian characters. No less than nine species of *Cœloplana* have been recorded after the discovery of *Cœloplana metschnikowii*. They are:—

(1) *Cœloplana willeyi*, Abbot, 1901—Misaki, Japan.
(2) *C. mitsukurii*, Abbot, 1901—Misaki, Japan.
(3) *C. bocki*, Komai, 1920—Misaki, Japan.
(4) *C. gonactena*, Kremf, A. 1920—Coast of Annam.
(5) *C. astericola*, Th. Mortensen, 1927—Amboina and Kei Islands.
(6) *C. duboscqui*, Dawydoff, 1930—Gulf of Siam.
(7) *C. agniæ*, Dawydoff, 1930—Coast of Annam.
(8) *C. echinicola*, Tanaka, H. 1932—Japan.
(9) *C. bannwarthi*, Krumbach, Th. 1933—Gulf of Suez.

Prof. W. M. Tattersall, of the University College, Cardiff, Wales, delegate to the Silver Jubilee Session of the Indian Science Congress last year, visited the Krusadai Island Biological Station to study its fauna. On 7th February 1938, while examining certain sea-weeds, chiefly *Halimeda opuntia* collected from the Galaxea Reef lying to the east of Krusadai, he came across a specimen of *Cœloplana*. Unfortunately, he could not continue his observations as he had booked his passage and was due to leave for Colombo the next morning.

The work, therefore, of observing the habits and describing and identifying the Krusadai form was very kindly entrusted to us by the Professor and what facts we were able to collect within the short time at our disposal form the subject of this paper. The large number of species of *Cœloplana* recorded since 1880 made it impossible to settle the identity of the species to which the Krusadai *Cœloplanæ* belonged or to say definitely if they constituted a species new to science within the short time at our disposal.

As the sequel will show, it is likely that in our material—a dozen specimens†—is included more than one species of *Cœloplana*. For the present, therefore, we content ourselves with alluding to Krusadai *Cœloplanæ* in this paper rather than to particular Species.

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* Published with the permission of the Director of Fisheries, Madras.

† The one discovered by Prof. Tattersall broke to pieces when he attempted to kill it with cold corrosive.

2. Habitat and Habits

The locality where these animals live is a coral reef consisting mostly of dead corals within the tidal zone open to the action of the surf at high tide. If sea-weeds chiefly *Halimeda opuntia*, collected from the shallow streams caused by the receding sea at low tide when the reef is exposed, are left in a glass-dish with sea-water, one finds a few specimens on favourable occasions either creeping to the side of the glass or floating on the surface of the water. None has been collected from the plankton and it is therefore reasonable to conclude that these *Cœloplanæ* do not float in the sea, agreeing with other species in this respect. It is presumed that they normally adhere to or creep on the broad fronds of *Halimeda opuntia* in the natural state; but, in the laboratory, under artificial conditions, they float sometimes. Their powers of adhering must be of no mean order; for during the North-East Monsoon the sea in this area is one mass of roaring breakers and no living thing having anything short of strong roots can retain its foothold there. Our observation on one specimen from 20th June 1938 to 23rd June 1938 showed how the two extraordinarily long tentacles with their uniserial branches served the purpose practically of adherent roots. While tilting the cavity-slide to transfer the animal into a petri-dish, it threw out both the tentacles almost to their full length and spread out the branches on to the body of the slide like two parallel cables anchoring on by means of their branches (Fig. 1). The collablasts or adhesive cells on these tentacles doubtless will help the tentacular apparatus to stick to the substratum and defy dislodgement. These *Cœloplanæ* also adhered to the bottom of the petri-dish by means of their ventral surfaces alone; but, with what effect, can be gathered from the fact that a jet of water with a small pipette easily made them give up their hold. The reader should refer to Abbott's account for a graphic description of the locomotion of *Cœloplanæ* in captivity and of the movements of the tentacles in particular. The circular lip of the pouch in which each tentacle is contained is so mobile when the animal is active that one is reminded of a mouth rather than of the opening of a blind sac. The tentacles are paid out as a pair, or alternately, very slowly, now as a large bunch, now retracting, now again as a small bunch, as though the animal is testing the congeniality of the surroundings. One should, therefore, attribute a tactile function to these tentacles in addition to serving as adhering structures. The tentacles are said to aid in the capture of prey but we have not yet had evidence of this nor have we conducted experiments on this yet.

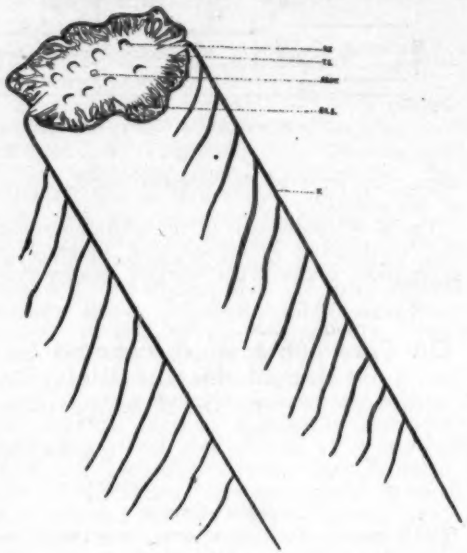

Fig. 1

Diagrammatic view showing the grey specimen of *Cœloplana* sp. putting out its tentacles like two cables and anchoring to the substratum with the help of its uniserial branches

AB.OT.–Aboral otolith; *T.*–Tentacle; *T.S.*–Tentacular sheath; *P.G.S.*–Peripheral portion of the Gastrovascular system; *R.T.*–Respiratory tentacles.

We have not been able to determine the food of these *Cœloplanæ* except on one occasion when a squillid which was casually introduced into the petri-dish where a *Cœloplana* was lying with his body folded ventrally along the tentacular axis like a book was found to have got within the fatal embrace of the folds. There it was for about five minutes, showing its cephalothorax and trying to escape, but the *Cœloplana* held it firm mostly with the aid of colloblasts, we presume, and released it after, we presume again, it has sucked in its soft parts, for the squillid died soon afterwards.

3. External Characters

The respiratory tentacles are conspicuous structures rising from the aboral surface

varying from six to eight in number. They are either conical or blunt and knob-shaped and are arranged in two rows one on either side of the otolith and parallel to the tentacular axis. As the respiratory tentacles are known to be contractile, a conical tentacle may, if contracted, appear as a knob-shaped one and *vice versa;* but we have not seen these shapes interchanged in the same individual. The ciliation of the ventral surface has been noted by previous observers; while this ciliation was evident in most of the living specimens we examined, it was not descernible in one examined from 21st June 1938 to 23rd June 1938. This individual again was greyish in colour while the rest were olivaceous. As these animals are known to imitate the colour scheme of their surroundings, colour alone will be an insecure guide in determining specific values. Further study to settle this question of more than one species being included in the *Cœloplana* community off Krusadai is essential. The size of the animals varied from 3 mm. to 12 mm. in diameter.

The gastric canals are transparent and the circulation of food-particles can be watched not only in them in the living animals but in the respiratory tentacles as well, which form part of the gastro-vascular system. The Krusadai *Cœloplanæ* agree with other species in having no peripheral canal.

The tentacles, the virtual arms of the animal so to speak, have already been described in relation to habits. They show no deviation from the usual pair described hitherto by previous workers. The branches are uniserial and these are twisted into gnarls sometimes.

Attempts will be made to study the internal organisation and the embryology of Krusadai *Cœloplanæ* as time permits and opportunities occur.

4. Geographical Distribution

The species of *Cœloplana* hitherto described appear to be distributed in four zoogeographical regions as below:—

(*a*) Palæarctic Region—Japan.
Cœloplana willeyi,
C. mitsukurii,
C. bocki, and
C. echinicola.

(*b*) Ethiopian Region—Gulf of Suez and Red Sea.‡
Cœloplana metschnikowii and
C. bannwarthi.

(*c*) Oriental Region—Coast of Annam, Gulf of Siam and Gulf of Manaar.
Cœloplana gonactena,
C. aginæ,
C. duboscqui, and
the Krusadai *Cœloplanæ*.

(*d*) Australian Region—Amboina and Kei Islands between Celebes and New Guinea.
Cœloplana astericola.

Till now no species of *Cœloplana* have been recorded from the Nearctic Region, the Neotropical Region and the Polynesian Region.

‡ This section borders on the Palæarctic Region.

5. Resumé

(1) The Krusadai *Cœloplanæ* are littoral in habit and are found in association with sea-weeds, chiefly *Halimeda opuntia*.

(2) The tentacles in addition to other functions may serve for the purpose of adhering firmly to the substratum as the area where they occur is subject to the action of the surf.

(3) The two different shapes of the respiratory tentacles and other characters touched upon may point to the occurrence of two species in the *Cœloplana* community off Krusadai. This is being investigated.

(4) The genus *Cœloplana* seems to be confined to the old world.

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LETTERS TO THE EDITOR

'Clean up' under Canal Ray Discharge

'CLEAN UP' in discharge tubes is a phenomenon that has often proved of interest, and is characterised by a sudden diminution of pressure, on initiating the discharge. The chief mechanisms[1] by which these are brought about are (1) through the agency of a "*getter*", (2) by the action of the electrical field in driving the ions bodily into the walls of the discharge tube and the metal electrode. It is conceivable that (1) and (2) may operate simultaneously and may, in fact, be mutually helpful. It is clear that (2) will be more prominent under conditions of the canal ray discharge on account of the higher operating voltages, etc. As the effect had a certain interest from the standpoint of another phenomenon, it was studied with picein[2] vapour as the "getter" with hydrogen as the gas in the discharge tube.

Since it was impossible to measure these rapid fluctuations in pressure by means of any elaborate measuring apparatus, attention was restricted to observing the fluctuations in the voltage, as measured by a sensitive H.T. voltmeter of the Kelvin-Whyte type, keeping the other electrical parameters, like the discharge current, the wattage input to the H.T. transformer, constant, during the course of the experiment. Under these conditions the voltage becomes a sufficiently accurate index of the pressure.

On the first addition of the getter to the discharge tube, the secondary voltage rose up rapidly as was to be expected, when it was tried to restore the pressure by allowing small amounts of hydrogen. At each such measure, the voltage fell down momentarily only to rise again to its high value, though the time rate of increase diminished after each addition. Finally, a stage was reached when the voltage after rising to its maximum, automatically fell down and showed signs of attaining a steady

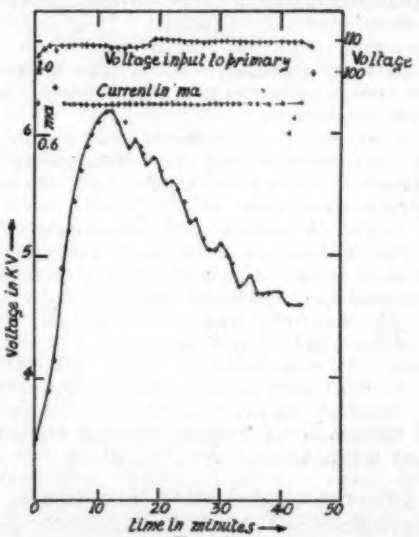

FIG. 1

value. This fall was characterised by a series of rapid fluctuations of small amplitude. In some experiments the same cycle of initial rise and subsequent fall was repeated. Significant changes in the colour of the discharge[3] accompany these fluctuations; in the absorption regime when the voltage is increasing, the colour of the discharge is that of hydrogen, during the regime of de-absorption, when the voltage is falling, there is a preponderance of the bluish white colour.

Figs. (1) and (2) show two typical curves giving these fluctuations as function of time. Observations showed that they were present even after a lapse of two hours, which is very remarkable. In Fig. (2) curves A, B, C show the changes after successive additions of hydrogen.

In view of the repetition of cyclic changes in some of the cases, the results cannot be explained in terms of breaking up of an initial

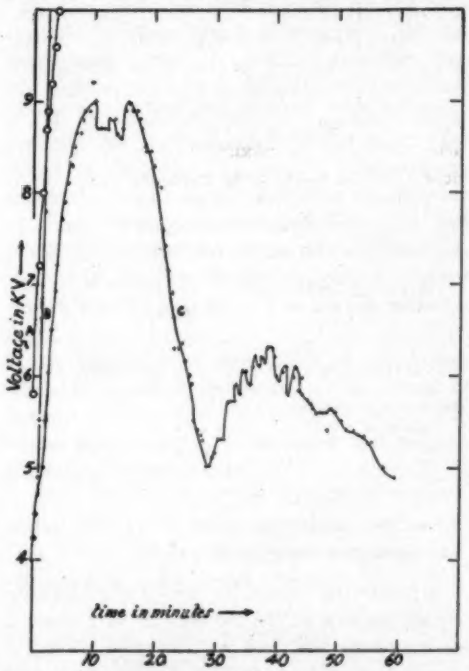

FIG. 2

layer on film by the subsequent effects of the discharge thermal or otherwise. One is led, therefore, to conclude that it is an instance of a periodic reaction (possibly adsorption). The pressures of the gas used in these experiments are of the order $10^{-2} - 10^{-3}$ cm. of mercury. The electrodes are both of aluminium.[4]

V. T. CHIPLONKAR.

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Benares Hindu University,
February 23, 1939.

[1] Koller, L. R., *Physics of Electron Tubes*. (McGraw Hill), 1934, pp. 86–97.

[2] Chiplonkar, V. T., *Proc. Ind. Sci. Congress*, Lahore, 1939, *Phys. Maths. Section*, pp. 25–26.

[3] Delaplasse, R., *Comptes Rendus*, 1936, **202**, 1986.

[4] Wien, W., "Kanalstrahlen," *Handbuch der Experimental Physik*, Akademische Verlags-gesellschaft, Leipzig, 1927, p. 468.

The Effect of Muscular Work on Protein Metabolism in the Ruminant

A review of the extensive literature on the effect of muscular work on the metabolism of proteins reveals the existence of two conflicting schools of thought, the one led by Mitchell, holding the view, that normally, and given a diet of sufficient calorigenic intake, increased protein metabolism is "not an inevitable consequence" of muscular work; and the other led by Cathcart, that work results in a definite, though often small, increase in nitrogen output, calling for an augmented protein intake to meet the extra needs.

Nearly all the available evidence on this subject has been obtained with experiments on humans. In the course of an investigation in this laboratory, on the protein requirements of working bullocks, it was noticed that muscular work resulted inevitably in a heightened catabolism of protein, reflected in an increased output of urinary nitrogen.

The experiments were conducted on four experimental animals, Bullocks of the Kangayam breed, well known for their hardiness and capacity for work, of as similar physical conditions as possible, with a live weight of 900–1,000 lbs. The ration fed consisted of Cholam (Sorghum) straw of uniform quality, and cotton seed as concentrate, throughout the long series of experiments. The roughage was

fed *ad lib.* all residues being measured to the nearest gram, the concentrate being adjusted by a preliminary run of nitrogen balance experiments to give a nitrogen equilibrium with the mixed ration fed, as determined by the balance sheet method. The muscular work performed was baling water at the Mhote for a measured number of hours, the number of buckets raised per hour being recorded by a hand-operated tally (45–50 buckets per hour), the lift being 20–25 feet for 40 gallon buckets. The nitrogen metabolism was studied for three 4-day intervals during continuous periods of work for 4, 6 and 8 hours of work.

From the results obtained for the nitrogen balance by determining intake and output in fæces and urine, linear regression equations were determined for the total nitrogen requirement at different levels of work, and their adequacy tested by the usual statistical methods. The results are given below:—

Equation (i) $y = 4{\cdot}79x + 46{\cdot}7$,

where y = Total nitrogen requirement (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE I

Fitted Regression

(Total nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	$(Y - y)$	$(Y - y)^2$
0	46	46·7	− 0·7	0·49
4	67	65·9	1·1	1·21
6	76	75·4	0·6	0·36
8	84	85·0	− 1·0	1·00

TABLE II

Analysis of Variance

(Total nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression	1	801	801
Deviation from linear regression	2	4	2
TOTAL ..	3	805	..

A similar equation was fitted for the nitrogen excretion in urine, as determined by analysis, representing the endogenous nitrogen metabolism of the animals. The results are given below:—

Equation (ii) $y = 2{\cdot}56x + 16{\cdot}6$,

where y = Endogenous nitrogen output (gms. per diem)

and x = Number of hours of work at the Mhote.

TABLE III

Fitted Regression

(Endogenous nitrogen. Grams/Diem)

Hours of work	Actual value Y	Calculated value y	$(Y - y)$	$(Y - y)^2$
0	17	16·6	0·4	0·16
4	26	26·8	− 0·8	0·64
6	33	32·0	1·0	1·00
8	37	37·1	− 0·1	0·01

TABLE IV

Analysis of Variance

(Endogenous nitrogen)

Variation between hours of work due to	Degrees of freedom	Sum of squares	Mean square
Linear regression ..	1	229	229
Deviation from linear regression	2	2	1
TOTAL ..	3	231	..

From the results presented above, the following conclusions may be drawn:—

(i) Muscular work is necessarily followed by an increase in the metabolism of protein, as is shown by the need for increased protein in the diet to produce nitrogen equilibrium to meet the increased output of endogenous nitrogen.

(ii) The quantum of dietary protein required to produce nitrogen equilibrium at different levels of work is a linear function of the quantum of work performed.

(iii) The quantum of protein metabolised is also a linear function of the quantum of work performed.

(iv) The increment in dietary protein necessary to restore the animal to nitrogen equilibrium for each increment in work (about 5 grams for an increment in work of 2 hours) is small, and reckoned in terms of the energy liberated by the extra protein metabolised, is entirely inadequate to account for the energy required for the extra work performed. The significance of this small increase in the protein of the diet is, therefore, to be sought in causes other than inadequate calorie intake.

Studies of the nitrogen partition of the urine of the animals during the course of the work, showed that the major part of the increased output of endogenous nitrogen was in the form of Urea + Ammonia, indicating that the deaminisation phase of protein metabolism was the most active. Creatine occurred sporadically but in insignificant amounts. Creatinine excretion was very regular (2·5–3·0 gm. per diem) at all levels from rest to intense work, indicating that during muscular work even at high levels, tissue breakdown did not result in the excretion of creatine or creatinine; the metabolism of these compounds obeyed Folin's law, for rest as well as intense muscular work.

The coefficient of digestibility of the dietary nitrogen remained unchanged at all levels of work.

Full details of this investigation will be published elsewhere shortly.

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February 15, 1939.

Optical Activity of Lac

It is surprising that the optical rotatory power of lac has, so far, not been investigated; this is probably due to the circumstance that lac possesses a deep orange red colour. The colour of lac can be removed either by treatment with decolourising carbons or by bleaching with hypochlorite. Both treatments yield a product sufficiently colourless to enable an accurate determination of its optical activity.

An alcoholic solution of *Kusum* seed lac (10 per cent.) was treated with norit and filtered under suction over a bed of Kieselguhr. The clear but slightly yellow coloured solution which was thus obtained was employed for the determination of its optical activity.

The decolourised solution of lac was fractionated into (1) sclerolac and (2) soft lac by the addition of 10 volumes of ether to a given volume of the alcoholic solution of lac; the optical activity of the two lac fractions was determined in alcoholic solutions.

Analogous experiments were carried out with a sample of *Kusum* lac which was bleached by hypochlorite. Table I gives the results.

Table I

Specific Rotation $[\alpha]_D^{25°C}$.

	Lac decolourised by norit	Lac bleached by hypochlorite
Whole lac	+ 60·71	+ 59·29
Sclerolac fraction	+ 54·83	+ 51·26
Soft lac fraction	+ 63·60	+ 59·96

Further work on the isolation of the optically active constituents of the sclero- and the soft-fractions of lacs is in progress. The optical activity of lac is a property which should be of great value in studying the reactions of lac with ureas, fatty acids and other substances.

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April 12, 1939.

The Thickness of the Surface Layer of the Soil Exchanging Moisture with the Adjacent Air Layers during the Clear Season at Poona

RECENT work[1,2,3,4,5,6,7] on the exchange of moisture between the soil and air layers near the surface of the ground has shown that during the clear season when the "surface layer" of the soil is so dry as to contain only hygroscopic moisture, the evaporation from the soil by day up to the maximum temperature epoch is compensated by re-absorption later of moisture from the adjacent air layers by the soil until the next morning. Further, it was shown that this exchange phenomenon is confined to the first inch or so of the soil, the diurnal variation of moisture at lower depths being negligible. The next question is what is the actual thickness of the "surface layer"? This engaged our attention during the current clear season. A brief report of the results obtained in the course of preliminary experiments is given below.

A series of brass cylinders, 4·75 cm. in diameter for exposing soil with depths ranging from 1 mm. to 40 mm. were made with their tops open and bottoms closed. Air-dry Poona soil passed through a 1 mm. sieve was filled in these vessels, the actual depths of soil being 1, 2, 3, 4, 5, 10, 20 and 40 mm. respectively. These were kept embedded in the ground with the top fully exposed to the atmosphere. The surface of the soil in the experimental vessels was at the same level as that of the soil outside. The experiment consisted of weighing the vessels at intervals to study the diurnal variations in the weights, *i.e.*, in the moisture contents of the soil samples. The table below is based on the observations made on the 23rd, 24th and 25th March 1939 and gives (1) the mean maximum weights of the soil samples (recorded in the morning), (2) the mean minimum weights of the samples (recorded in the afternoon about the maximum temperature epoch) and (3) the diurnal range of the moisture content, *i.e.*, (1) *minus* (2). At the bottom of the table, the relative humidity at the two epochs is also given.

TABLE I

Thickness of soil layer in millimetres	Mean *maximum* weight of soil in grammes	Mean *minimum* weight of soil in grammes	Difference between the mean maximum and minimum weight of the soil samples
1 mm. ..	2·720	2·454	0·266
2 ,, ..	5·936	5·608	0·328
3 ,, ..	7·645	7·173	0·472
4 ,, ..	11·102	10·524	0·578
5 ,, ..	13·152	12·464	0·688
10 , ..	26·951	26·170	0·781
20 ,, ..	54·288	53·574	0·714
40 , ..	102·950	102·254	0·696
Relative Humidity	51·3%	11·7%	Diurnal range = 39·6%

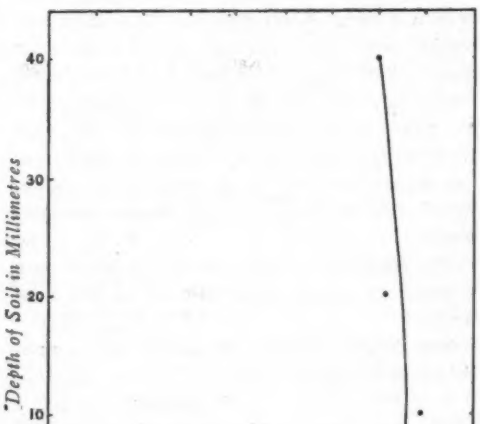


FIG. 1

The difference between the maximum weights and the minimum weights of the soil have been plotted against the thickness of the soil layer in Fig. 1. It will be seen that the difference in weight (this difference represents the weight of moisture lost by evaporation by the soil or gained by absorption from the atmosphere) increases with thickness up to about 10 mm., the variation being comparatively small thereafter, showing that the thickness of the "surface layer" of the soil which is affected by the diurnal exchange of moisture is of the order of a centimetre. The details of the experimental results will be discussed more fully elsewhere. Similar work with other typical soils of India is in progress.

L. RAMDAS.
A. K. MALLIK.

India Meteorological Department,
April 6, 1939.
Poona,

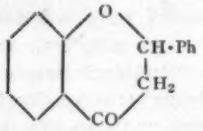
[1] Ramdas, L. A., *Curr. Sci.*, 1934, **2**, 445.
[2] — and Katti, *Ind. Jour. Agri. Sci.*, 1934, **4**, 923.
[3] — —, *Curr. Sci.*, 1934, **3**, 24.
[4] — —, *Ibid.*, 1935, **3**, 612.
[5] Katti, *Ibid.*, 1935, **4**, 419.
[6] Ramdas, L. A., and Katti, M. S., *Ind. Jour. Agri. Sci.*, 1936, **6**, 1163.
[7] — and Mallik, A. K., *Curr. Sci.*, 1938, **6**, 452.

Rottlerin V

NARANG, RAY AND ROY[1] isolated a second colouring matter (pale yellow needles, m.p. 181°) from the benzene filtrates in the preparation of rottlerin from Kamala. This substance has now been more fully investigated. We have found that it can be easily separated from rottlerin if the crude colouring matter is crystallised from toluene. The toluene filtrates on concentration deposits a sticky mass which, on dissolution in ether and chromatographic adsorption on alumina, separates into six zones. The first, darker zone, is that of rottlerin, the second zone contains the substance m.p. 181° (Found: C, 69·95; H, 5·57%, $C_{31}H_{30}O_8$ requires C, 70·19; H, 5·66% and $C_{30}H_{28}O_8$ requires C, 69·76; H, 5·4%). The other zones are being investigated. The clear ethereal filtrate gives a colourless waxy substance.

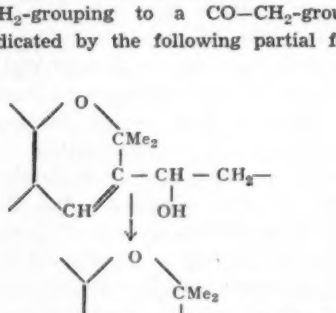
If rottlerin (5 g.) in 90% alcohol (250 c.c.) be heated with hydrochloric acid (15 c.c., density 1·14) for 7 hours (the solution becoming clear after 3½ hours) and then left overnight a solid deposit. The filtrate on dilution gave a pale yellow product which was crystallised from ether and found to be identical with the substance m.p. 181° isolated from natural sources. In later experiments the substance as obtained by dilution was purified by chromatographic adsorption on alumina. We have now come to the conclusion that this substance is identical with the substance m.p. 180° described by Brockmann and Maier[2] subsequent to our isolation of the substance in 1937. Brockmann and Maier have described it as a flavanone formed by the isomerisation of a hydroxy chalkone grouping in the rottlerin molecule. At first we were inclined to this view also, because the methyl ether of the substance (m.p. 135°–137°, not 105° as was wrongly reported[1] due to typographical error) gave a characteristic piperonylidine derivative (m.p. 145–147°, rectangular plates). Since rottlerin methyl ether did not give any condensation product with piperonal, therefore we thought that the easy formation of the piperonylidine derivative of this substance was due to the presence of $CO–CH_2$ group in *iso*-rottlerin. (We are adopting the nomenclature of Brockmann and Maier for this substance.) But the methyl ether of *iso*-rottlerin (Found: C, 71·64; H, 6·42; $C_{35}H_{38}O_8$ requires C, 71·67; H, 6·48; and $C_{36}H_{40}O_8$ requires C, 72·0 and H, 6·66%) prepared in a manner analogous to rottlerin methyl ether gave an oxide, with hydrogen peroxide similarly to rottlerin methyl ether. This substance (the oxide of *iso*-rottlerin) had m.p. 120–122° and gave C, 69·99 and H, 6·43% whilst $C_{35}H_{38}O_9$ requires C, 69·77; H, 6·3% and $C_{36}H_{40}O_9$ requires C, 70·01; H, 6·5%. On being heated just above its m.p. it evolved benzaldehyde copiously. Therefore, it seems

unlikely that the group $-CO\cdot CH=CH\cdot Ph$ is isomerised by the migration of a hydrogen from ortho-hydroxyl into



as has been supposed by Brockmann and Maier.[2]

The nitrosite of iso-rottlerin methyl ether had m.p. 194°–197° (decomp.) (Found: C, 63·36; H, 6·03). It seems that it is also formed exactly as in the case of rottlerin methyl ether by the addition of NO and NO_2 to one of the double bonds. We are engaged in reducing it by Pd and hydrogen and if any hydrogen is absorbed as it did in the case of rottlerin methyl ether nitrosite then the flavanone structure would be completely ruled out. In the meantime it may be observed that since iso-rottlerin methyl ether gives a piperonylidine derivative, and if the flavanone structure of iso-rottlerin is excluded and the $CH=CH\cdot Ph$ grouping is in tact in iso-rottlerin then the only other possibility is the saturation of the chromene double bond by isomerisation of a $CHOH-CH_2$-grouping to a $CO-CH_2$-grouping as indicated by the following partial formula



We have catalytically reduced iso-rottlerin. When the substance (2·0 g.) isolated by the elution of alumina was directly reduced, 230 c.c. of hydrogen was adsorbed at N.T.P. Two double bonds require about 180 c.c. But in this experiment we obtained two substances, one m.p. 209°, and the other, m.p. 225°–228° (decomp.). It seemed that there has been hydrogenolysis. The substance m.p. 209° gave C, 69·72, H, 6·02 ($C_{31}H_{32}O_8$ requires 69·92, H, 6·01 and $C_{31}H_{34}O_8$ requires C, 69·66; H, 6·3%). The substance m.p. 225°–228° gave C, 68·91 and H, 6·41, $(C_{11}H_{12}O_3)_n$ requires C, 68·7; H, 6·2%. In a second experiment, where iso-rottlerin purified by several crystallisations was employed for the reduction 2·0 gr. adsorbed 95·0 c.c. at 17°/746 mm. and the hydrogenated product m.p. 209° only was isolated, no trace of the higher melting substance being formed. But in this experiment a little iso-rottlerin could be detected as unreduced. Therefore we are not yet in a position to form any conclusions with regard to the number of double bonds in the molecule.

Further experiments are in progress and the details will be published elsewhere later on.

(The late) HARBANS SINGH BAKSHI.
RAVI S. JALOTA.
K. S. NARANG.
J. N. RAY.

The University,
Lahore,
April 6, 1939.

[1] *J.C.S.*, 1937, 1863.
[2] *Annalen*, 1938, **535**, 170.

On the Occurrence of an Eocene Bed in the Pondicherry Cretaceous Area, S. India

IN the course of a recent examination of some of the rocks from the Pondicherry Cretaceous area, I find that one of the limestones contains a foraminiferal fauna of extraordinary interest, which definitely indicates a lower Eocene age. Sections of this limestone are seen to be crowded with *Discocyclina* (Fig. 1), and what is perhaps even more important and valuable is that, in addition to this, we have also plenty of *Nummulites* [*Camerina*]. The discovery of such a striking association of *Discocyclina* and *Nummulites* in a limestone coming from an area

which has hitherto been considered as composed exclusively of Cretaceous rocks naturally arrested my attention, and on further study, it

FIG. 1

was obvious that here we have the occurrence of a bed with a foraminiferal fauna comparable in certain respects with that of the Paleocene beds of N.W. India. In making sure of this point, I have had the valuable collaboration of my friend Mr. Y. Nagappa, Assistant Palæontologist, of the Burmah Oil Co., who very kindly undertook to examine these foraminifers in greater detail and also compare them with the types described from the Eocene beds of N.W. India. As a result of this work, it is clear that these Pondicherry foraminifers are very similar to, and in some cases (as for instance, certain species of *Discocyclina* and *Cibicides*) identical with those recorded from the Ranikot stage in N.W. India. Thus it would appear that the marine transgression during the later part of the Cretaceous period, which gave rise to the upper Cretaceous beds of this area, lingered on even into Paleocene times.

This discovery, on the east coast of India, of a lower Eocene bed, with a similarity in its foraminiferal fauna to contemporaneous beds in N.W. India, is evidently of far-reaching significance and importance; and this will be discussed in a more detailed paper to be published in due course.

My best thanks are due to Mr. Y. Nagappa for his valuable assistance in the study of these foraminifers, and to Mr. C. A. Sansom, Chief Geologist of the B.O.C., Burma, for giving Mr. Nagappa the necessary permission and facilities for doing this work in the Company's excellent Palæontological Museum at Khodaung, and for permitting me to publish these results.

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April 5, 1939.

Lepidocyclina from the Agate Conglomerates near Surat and Broach (Western India)

THE agate conglomerates between Surat and Broach occupy a large tract of the country and often attain considerable thickness. They are frequently associated with ferruginous sandstones which contain small agates and rounded trap pebbles. All these beds are fossiliferous and occur as outliers surrounded by the Eocene Nummulitic beds. In several sections on the banks of the Tapti, near Tarkeshwar and Kimamlee, they are found resting on the Nummulitic series. In a collection of fossils I recently made from the conglomerates and the associated sandstones, I have noticed the presence of foraminifera of the important genus *Lepidocyclina* which, as is well known, is confined to the Oligocene (Nari) and Miocene (Gaj) beds of the Indian region and elsewhere.[1] The *Lepidocyclina* noticed in these beds are small forms and are represented by two species which are different from those hitherto recorded from India.[2] One of these, *L.* (*Lepidocyclina*) sp. nov. [Fig. (*a*) & (*b*)] shows some resemblance to *L.* (*Lepidocylina*) *canellei* Lemoine and R. Douville. The microspheric and megalospheric generations are both represented in my collections. The other species is *L.* (*Nephrolepidina*) *sumatrensis* Brady var. nov. [Fig. (*c*) & (*d*)]. The affinity to the type

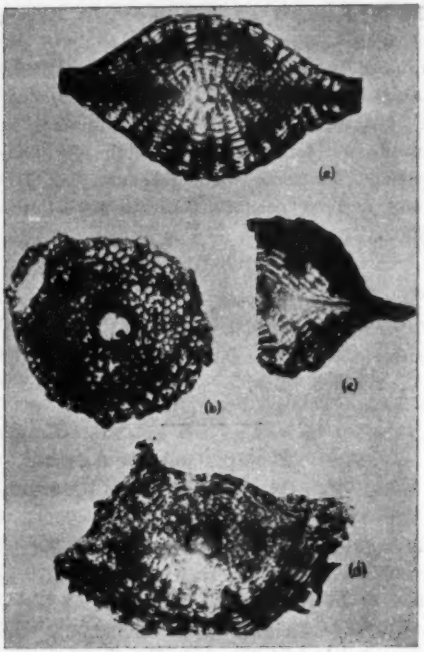

FIG. 1

(*a*) Meridian section, and (*b*) Equatorial section of *L.* (*Lepidocyclina*) sp. nov. (A.-form). × 25. Loc.—Kimamlee, near Surat. (*c*) Meridian section, and (*d*) Equatorial section of *L.* (*Nephrolepidina*) *sumatrensis*, Brady, var. nov. (A.-form). × 25. Loc.—same as above.

species from Sumatra is very marked and the differences are only of a varietal degree. Prof. H. Douville,[3] in his scheme of classification for the Far-East, has noted that small *Nephrolepidina* of the type represented by the species *sumatrensis* as characteristic of the Burdigalian stage. The agate conglomerates and the associated sandstones may, therefore, be assigned to the corresponding Indian stage in the Gaj series.

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University of Mysore,
April 5, 1939.

[1] Lt.-Col. L. M. Davies has recently described *L.* (*Polylepidina*) *punjabensis* Davies, from the Ranikot (Paleocene) beds of the Punjab Salt Range (*Pal. Ind.*, n.s., 1937, **24**). This appears to be a very unusual occurrence. According to Vaughan (*Biogeographic Relations of the Orbitoid Foraminifera*, 1933), *Lepidocyclina* and its allies appear to have originated in America during middle and upper Eocene time and migrated from there to other parts of the world. Vredenburg and Nuttall both regard this genus as confined to the Oligocene and Miocene of Indian beds.

[2] Nuttall, W. L. F., *Ann. Mag. Nat. Hist.*, 1926, **17**, 330–37.

[3] Douville, H., *Mem. Geol. Soc. Fr*, 1925, **Mem. 2**, 84.

A Note on the Occurrence of a Chlorophyll Deficiency in Linseed (*Linum usitatissimum* L.)

A CHLOROPHYLL deficient plant was observed in the Botanical Section at Pusa in a field of the linseed variety, Pusa Type 12 (Howard and Khan),[1] in 1933–34. This plant was quite distinct from the surrounding plants, the terminal portions of all its branches being yellow and the lower parts containing only a small amount of chlorophyll making these portions look greenish yellow (Fig. 1). As in

Left: Normal green plant of Type 12.
Right: Mutant plants.

Type 12, the flowers were pale blue and did not open fully. The plant was stunted and produced very few seeds. In the following year it bred true for the chlorophyll deficient character. The cotyledonary leaves of the seedlings were normal green, but the chlorophyll deficiency was visible from the first pair of true leaves, the growing points of the seedlings showing the characteristic yellow colour. The original plant

appears to have arisen as a mutant from Type 12.

In F_2, fifteen cultures were grown in 1937–38. They behaved as follows:—

Cultures	2	3	6	7 A	8A	18 B	26 B	28	29
Heterozygous—									
Green	46	35	19	17	15	23	15	29	25
Chlorophyll deficient ..	8	9	8	5	5	6	5	4	4
TOTAL ..	54	44	27	22	20	29	20	33	29
X^2 (3 : 1)	3·19	0·48	0·31	0·05	0·00	0·29	0·00	2·92	1·95

Cultures	11	13 A	17	24	25	30
Homozygous—						
Green	46	37	48	..	..	..
Chlorophyll deficient ..	..	..	..	12	18	22

Chlorophyll deficiency in *Linum* has been reported by Fischbach.[2] He observed variegated plants in the F_1 of *Linum hirsutum* × *L. viscosum*, although both the parents were normal green.

The new mutant type was crossed with Type 12 (T. $\underset{\text{♀}}{12} \times \underset{\text{♂}}{\text{Mutant}}$) in 1934–35 and in 1935–36 the F_1 was grown. The F_1 plants were normal green like the Type 12 parent and could not be distinguished from it except by their hybrid vigour, being more vigorous in growth and slightly earlier in maturity than either parent. The green condition, therefore, is completely dominant to the chlorophyll deficient condition.

The F_2 progeny was grown in 1936–37 and the results given below were obtained:—

	Green	Chlorophyll deficient	Total
Observed	268	100	468
Expected on 3 : 1 basis	351	117	468

$X^2 = 3·29$ and P is between 0·1 and 0·05; the fit is fair.

In all the above segregating cultures there is agreement between the observed and the expected frequencies and the ratio of homozygous to heterozygous cultures in F_3 also approximates to expectation. The results, therefore, clearly indicate a single factor difference between the normal and the chlorophyll deficient conditions.

It may, however, be pointed out that in F_2 and in the majority of F_3 cultures there is a deficiency in the chlorophyll deficient class. This may be due to the death of some of the chlorophyll deficient plants, which, being very weak, could not grow as well as the normal plants. Dead plants which seemed to belong to this class were actually observed while taking the counts, but were not taken into consideration.

R. B. DESHPANDE.

Imperial Agricultural Research Institute,
New Delhi,
April 3, 1939.

[1] Howard, G. L. C., and Khan, A. R., *Mem. Dept. Agric. India* (Bot. Ser.), 1924, **12**, 1.

[2] Fischbach, C., *Z. indukt. Abstamm. U. Vererb. Lehre*, 1933, **65**, 180.

Pinkish Vacuolar Stain in Growing Tips of Fungal Hyphæ in Artificial Culture

In the course of my work on artificial cultures of *Polypores* I have found a pinkish stain (a very light tint—"Hermosa pink" of Ridgway—visible only after very careful examination under the oil-immersion lens) in the vacuoles of the growing tips as well as a little older portions of all hyphæ (Fig. 1); it is found not

Polystictus sanguineus in culture, Young hyphæ (one with clamp) showing vacuoles which are coloured pinkish (Camera lucida-sketch under oil immersion lens 2 mm. and eye-piece No. 5)

only in cases of coloured species (*i.e., Polyporus rubidus, Polystictus sanguineus, Polystictus versicolor, Trametes persooni, Dædalea flavida,* etc.) but in perfectly white species like *Polyporus ostreiformis.* Subsequently, extending my observations I found almost the same stain in diverse groups of fungi like *Mucor, Yeast, Aspergillus, Penicillium, Beauvaria, Ascoidea rubescens,* etc. The stain becomes fainter in very old hyphæ and is not found in dead double-walled hyphæ or hyphæ undergoing fatty degeneration. Brownian movement was noticed in some of the vacuoles which are generally of varying dimensions. The vacuoles were all naturally coloured pinkish, the pigment evidently being in a state of solution. Gulliermond[1] recorded that in the meristem of a higher plant (very young root of *Ricinus*) all the vacuoles are naturally coloured red without the use of any artificial vital-colouring agent like the neutral red, due to the presence of anthocyanin pigment. He has figured such vacuoles. The nature of the pigment is, however, quite unknown here; the pigments in fungi are so different from those in higher plants that it becomes difficult to describe them by any known term.

Kögl[2] while recently summarising our knowledge about pigments in fungi has indicated how little is known about them with certainty; in very few cases he could supply the definite chemical composition of the pigment. And in all these cases the pigments that have been described, are deposited on the walls of dead hyphæ giving rise to the prevailing naked eye-colour of the outer surface of the sporophores. The pigments in vacuoles of living hyphæ have not been dealt with so far. In the present state of our knowledge, though we cannot go further, I think it may be safely put forward that this stain has some connection with the metabolic stage of the fungus as being found only in actively growing hyphæ and becoming scarce in very old and dead hyphæ and in older cultures.

The pinkish stain of the vacuoles is insoluble in petrol-ether, ether, chloroform, alcohol (higher and lower grades), in hot and cold water and has no apparent connection with light, it can develop in the dark as well. It is also insoluble in weak acids and alkalies; with 8 to 10% caustic potash the pinkish stain becomes much fainter with the contraction of vacuoles, it turns greenish, in some cases whitish; with 10% acetic acid the majority of the vacuoles turns greenish or whitish though a few still retain the original pinkish colour. With H_2O_2 it does not turn yellowish. Thus, the chemical tests so far do not lend support to its belonging to the group of anthocyanins as found in higher plants. I shall be glad to have the experience of other workers on the point.

Any kind of chemical analysis (whether micro- or macro-) of the pigment in such vacuoles seems impossible with such a small

quantity, nor any absorption-spectrum could be obtained.

S. R. Bose.

Botanical Laboratory,
Carmichael Medical College,
Calcutta,
April 1, 1939.

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[1] Gulliermond, A., and others, *Traité de Cytologie Végétale*, Paris, 1933, 302–3.

[2] Közl, F., Pilzfarbstoffe in G. Klein's *Handbuch der Pflanzenanalyse*, Wien, 1932, **Band III/2**, 1411–36.

Recurrent Pseudo-Mutations in Sorghum

Mutations are of frequent occurrence in the plant world. When these occur there is a sudden change in the genic constitution affecting the progeny. Instances of mutations that occur without conforming to this simple nature are on record. In some of these cases the mutations occur late in the development of the seed so that the embryo remains unaffected. The mutation affects parts of the seed other than the embryo.

These rare phenomena have therefore been called *pseudo-mutations*. *Recurrent* pseudo-mutations are rarer still. Imai (1935)[1] records two instances one each in the seed coat of *Phaseolus vulgaris* and *Pisum sativum*. The occurrence of recurrent pseudo-mutations in the seed coat colour and nucellus colour of sorghum grains is recorded below.

Pericarp Brown.—In the year 1926 in family number A.S.1349, which segregated for brown and white grains, one brown grained earhead with a few white grains on it was noticed (see illustration). The seed from this earhead was sown in 1927 (A.S.1958). It gave a simple monohybrid segregation for brown and white grained earheads. In the 62 brown grained earheads, there were 4 with stray white grains, a repetition of the 1926 experience. In these four earheads the number of white grains were 3, 4, 4 and 14.

In 1933 a similar experience occurred in family A.S.3277 segregating in a 9:7 ratio of

Stray white grains occurring among brown grains in sorghum through pseudo-mutation

brown and white grains. In one out of 128 brown grained earheads, this experience was observed, the number of white grains being 14. This earhead was sown (A.S.4784) and its progeny segregated for brown and white grains. In the brown grain population of 176, this phenomenon was repeated in 3 earheads, one of them giving as many as 21 white grains. It should be mentioned that the 14 white grains separated from the brown grained earhead were sown separately. From these, 7 plants grew to maturity, and of these, 5 were brown grained and 2 white grained. None of the 5 brown grained earheads exhibited this phenomenon of pseudo-mutation. The mutating tendency was in the family and was not perpetuated preferentially through the actual grain which is the resultant thereof.

These pseudo-mutations recurred in the third year also. The earhead in which 21 grains were white was sown (A.S.5518) and in the progeny, consisting of 234 brown grained and 81 white-grained earheads, there were 3 earheads in which the phenomenon recurred. In

the progeny from three other sister heads without evidence of pseudo-mutation, this phenomenon occurred in 14 earheads. In one of these the number of white grains was 30.

Similar experiences were met with in two other cases. In one of these cases the earhead that mutated did not repeat the behaviour but some of the all-brown grained sister heads exhibited the mutating phenomenon. In all the above families the progeny segregated for brown and white grains. The plants which mutated were very few (1 to 8 in a population of about 200 brown-grained plants), and the number of grains in each earhead was also very few (1 to 30 in a total of 2,000 to 4,000 grains per earhead). The most noteworthy point in this experience is that the pseudo-white grains separated and sown gave both brown and white grained plants, similar to the progeny from the brown grains in the earhead.

Nucellar Brown.—Pseudo-mutations also occurred in earheads in which the grains have their nucellus coloured brown. In such earheads odd grains with no colour in the nucellus occurred. These grains stand out less prominently from the mass of nucellus coloured grains than in the previous instance, where the white grains are in marked contrast to the mass of grains with brown pericarp. In family A.S.4930, that segregated for brown coloured nucellus to no colour in the nucellus, there occurred one earhead in which 49 grains were without colour, while in the rest of the grains (1040) the nucellus was coloured brown. This earhead was sown with the grains separated. The progeny from seeds with coloured nucellus, segregated for nucellar colour. In these 11 earheads with coloured nucellus repeated the parental pseudo-mutation experience. From 24 white grains sown, only 6 plants grew to maturity, and 5 of these gave earheads with nucellus coloured brown and one without colour; of the 5, three earheads mutated. In one of these earheads, almost a sixth of the number of grains had no colour in the nucellus.

There are evidences of reversibility of these pseudo-mutations; also the possibility of their constancy in occurrence. These aspects are under study.

G. N. Rangaswami Ayyangar.
M. A. Sankara Ayyar.
A. Kunhikoran Nambiar.

Millets Breeding Station,
Agricultural Research Institute,
Coimbatore,
March 25, 1939.

[1] *American Naturalist*, 1935, **69**, 456–59.

Excitability and Responsiveness

The confirmation from Annamalai[1] of the new views on the Physiology of Vision which originated in Lucknow have a natural interest for me. In connection with them I would point out that Dr. Naidu started from an advantageous position in the form of the open mind. In contrast with this the various authorities whom he quotes have started out with a firm faith that the phenomena ought to have their explanation in terms of the actions of electric currents on isolated muscle or nerve.

A further discovery from Lucknow is that all who have so far dealt with these and kindred matters have been bemused by the seeming comprehensiveness of one of our fundamental definitions, *viz.*, that of excitability. Fredericq recently defined this as the property which a living tissue possesses of answering by a change in shape, state, or position to a modification occurring in the surrounding medium. This definition is a wide one and covers the excitation of an isolated muscle or nerve by electric currents, the stimulation of beating hearts by drugs, and our own reactions—*e.g.*, to start at the sound of a motor horn—to our environment. Hence, the reasonable inference that all these reactions to environment are mediated by the common possession of excitability.

All physiologists save myself have made exact studies of this excitability by electrical methods. I started its investigation by stimulating beating hearts with drugs, but, after regularly obtaining thereby results always at variance with those obtained by electrical

methods, I could but conclude that I was investigating something else. I could not have been so doing if the definition of excitability given above had that validity so far accorded to it, but the facts were there to prove the difference. Accordingly I have called the property, responsiveness, which I found myself investigating, and left excitability to designate the property investigated through electric currents.

The difference between these two properties can be made clear through motor cars. The excitability of a motor car is definable as the capacity of the gases in its cylinders to explode under the influence of the electric spark. In contrast with this, its responsiveness is its capacity to have its activity varied through feeding the cylinders with different mixtures from the carburettor.

Living tissues in the body are in a condition comparable with that of a motor which just ticks over, and their natural stimulation is effected by a process akin to that of altering the setting of a carburettor. A living carburettor, however, has so far had no existence in our philosophy. The gap was bridged by hypotheses whose nature may also be grasped through the motor car. All of us believed, and some of us still believe, that the accelerator pedal is directly connected with the sparking mechanism and that changes in the explosions follow on alterations in the sparking mechanism. In effect, controversy still goes on between a school of thought that believes that pressure on the accelerator pedal improves explosions through making the spark long and thin, and a school that believes the spark becomes short and fat. Both schools carefully examine evidence concerning the thinness and fatness of sparks, and believe that it is not nice to know or mention such things as carburettors.

If these Lucknow views were correct prediction would be possible. Things are so, and I conclude with two examples given below.

The confirmations were done without knowledge of the existence of the predictions. Hence there can be no doubt that Prof. Adrian's findings were not biased by preconceived notions. And in matters physiological prediction was never previously possible.

Deductions	Confirmations
Burridge.—A New Physiological Psychology, Arnold, London, 1934.	*Adrian.—Proc. Roy. Soc. Med.*, 1936, 29, 197.
P. 43.—The picture thus presented of an organ of mind shows it as consisting of a vast complex of discrete groupings of neurones, each group dancing to its own tune with its own strength.	The cortex need not be regarded as a system of several million independent units. The cells act in groups, small or large.
P. 54.—....there exists an integrative tendency which determines that groups of neighbouring yet isolated neurones must seek a common rhythm and a resultant.	Nerve cells are rarely at rest, but tend to discharge periodically, though there may be no afferent excitations to arouse them.
	Group of nerve cells tend to act in unison when there is nothing to prevent them. These co-ordinated waves of activity express the tendency of nerve cells to associate together.

W. Burridge.

Department of Physiology,
King George's Medical College,
Lucknow,
March 16, 1939.

[1] *Curr. Sci.*, 1938, 7, 273.

REVIEWS

Cattle Fodder and Human Nutrition. By Artturi, I. Virtanen. (Cambridge University Press, London), 1938. Price 7/6 net.

In a series of four informative and stimulating lectures delivered at the Universities of London and Reading, Professor Virtanen develops the theme that the biological fixation of nitrogen constitutes the fundamental basis on which rests the production of milk. Leguminous crops which derive their nitrogen from the atmosphere, through the agency of symbiotic bacteria, provide cattle with protein-rich nutriment thereby enabling them to yield milk. The culture of legumes has another important function; to enrich the soil by excreting nitrogenous materials which are utilised by the associated non-leguminous plants. Professor Virtanen has thrown new light on the mechanism of the biological fixation of nitrogen which forms the subject-matter of his first lecture which the reviewer had the pleasure of listening to at Cambridge. He has established the scientific rationale of an ancient, time-honoured and widely prevalent practice of raising cereals and legumes as a mixed crop.

In northern countries which are faced with long winters, the problem of milk production is one of vital importance. The cows have to be stall-fed during the greater part of the year and the question of providing them with a protein- and vitamin-rich fodder is one which has received the close attention of Prof. Virtanen and his co-workers. The A.I.V. process discovered by them has solved the fodder problem; this has enabled the Finnish farmers to produce in the winter months, milk of a quality and a vitaminic potency which is equivalent to that produced in summer. This is an achievement of which Prof. Virtanen may well be proud.

In India, the quality of milk with respect to its protein, fat and vitamin content, varies widely. In summer months, the problem of fodder is acute; Professor Virtanen's process of preserving fodder deserves to be widely investigated to suit local conditions.

The volume is one of topical interest, raising as it does the problem of human nutrition. It is a book which should be widely read not only by investigators but also by administrators who are interested in planning a sound policy of national nutrition.

M. S.

The Basic Mechanics of Human Vision. By R. Brook Simpkins. (Chapman & Hall, Ltd., London), 1939. Pp. 228. Price 12/6.

This is an interesting book whose author takes the view that accommodation of the eye is brought about by an elongation of its axis effected through its extrinsic muscles. In this he admittedly follows Von Arlt, and brings to the aid of the hypothesis a wealth of mechanical data. The reviewer believes, however, that the author has not sufficiently studied the evidence of fact evinced by Sansom's or Purkinge's images. Their observation demonstrates that the only structure which can be seen to change during accommodation is the anterior surface of the lens, is posterior surface and the cornea remaining fixed. Hence, admitting for argument that there is an elongation, it must be the posterior part of the eyeball that moves. If such were the case, Purkinge's figures should change position on accommodation, but the reviewer failed to find evidence of this. On the whole, then, the reviewer believes that accommodation in man is effected differently from that in certain fishes.

It is evident from the book that the author has not undergone any medical training. For, had he done so, he would have been more chary of introducing theories of plus, static and minus innervation of muscles. What the author is trying to get at here is apparent to a medical man, but the latter would not describe the phenomena as is here done.

An absence of medical training also deprives the author of the opportunity to discuss those very interesting drugs, atropine and pilocarpine. The intrinsic and extrinsic muscles belong to two different classes of muscles which react differently to the actions of drugs, electrical stimulation, *et hoc genus omne*. It would be a most extraordinary phenomenon if atropine acted on the extrinsic muscles, and an equally extraordinary phenomenon if atropine acted on the

intrinsic ones. There is, moreover, a wealth of experimental evidence which demonstrates that the atropine and pilocarpine act only on the intrinsic muscles of the eye. Since also there is no doubt of the ability of atropine to paralyse accommodation, it should be accepted that the muscle which atropine paralyses, the ciliary muscle, is the one concerned in accommodation.

As regards the instruments invented by the author for eye exercises, the reviewer may first be permitted to express a dislike for their hybrid names. But, putting that aside, while there is adequate evidence concerning the manner in which the instruments are intended to be used, there is a deplorable lack of evidence concerning their usefulness. An Appendix giving, say, a series of 200 cases with their original conditions, the nature and duration of the treatments and the results, would remedy this defect. The reviewer is quite prepared to believe that a mode of treatment based on erroneous hypotheses may yet be beneficial.

W. BURRIDGE.

The Evolution of Genetic Systems. By C. D. Darlington. (Cambridge University Press, London), 1939. Pp. 149, text-figs. 26. Price 10/6 net.

The title of this book was the title of the last chapter in the first edition of Dr. Darlington's text-book *Recent Advances in Cytology*. That chapter was omitted from the second edition. It has now been expanded and the cytological facts which account for the phenomena of genetics are simply and concisely expounded in a handy volume.

This is a lucid and readable resumé of much that is set forth in the author's longer work, set down briefly and unhampered by exhaustive series of examples and references.

Genetics is concerned with reproduction. This book contains a clear account of the behaviour and evolution of the visible determinants of heredity in the cell nucleus, *i.e.*, the chromosomes. There are concise descriptions of meiosis, chromosome mechanics and the mechanism of genetic crossing-over according to the latest discoveries and system of nomenclature. The evolution of polyploidy, of differential chromosomal complements by structural changes, of permanent hybrids, of sex inheritance, of sterility and apomixis are traced. The penultimate chapter deals with the manner in which the units of heredity, the genes, act upon the nucleus, cytoplasm and body as a whole. The final chapter surveys the evolution of reproductive systems from the naked gene and also the broader implications with reference to the evolution of species and to the classical theories of Lamarck and Darwin.

There is a bibliography of ninety-one titles and an excellent index. This little book by the world's foremost cytologist will be welcomed by everyone interested in the mechanism of heredity; not only cytologists and geneticists but teachers, medical men, professional breeders and all members of the public who wish for reliable, up-to-the-minute information on modern "natural philosophy".

EILEEN W. ERLANSON.

Cotton Breeding and Seed Supply. (Published by the International Institute of Agriculture, Rome), 1938. Pp. 71. Price 15 lire, post free.

This is a companion volume to the monograph on *World Cotton Production and Trade* published by the above Institute in 1936. It is, as stated by the Secretary-General of the Institute, compiled from information given in books, reviews and from answers furnished to a questionnaire, by institutions and workers engaged in cotton research.

Although breeding in cotton has been practised for a long time in a number of countries both by private breeders as well as by staff employed in Government institions, there are few publications giving a connected account of the methods adopted and of the results obtained therein. This volume will, therefore, be welcomed by all cotton workers as one supplying a long-felt want.

The first chapter is devoted to the description of the objectives in cotton breeding where, rightly enough, prominence is given to improvement of yield; and valuable information is supplied under the improvement of quality. It is felt, however, that sufficient stress has not been laid on the interrelation between quantity and quality and on their combined effect on the economics of the grower. The presentation of Harland's schematic analysis of yield and the statement that "selection work has to reckon with all those characters when looking out for mother plants" leave an impression that isolation of types possessing such

characters will automatically result in increased yields. But actually it is well known amongst all cotton breeders that it is only the final weight of lint obtained per unit area that counts, owing to many unknown physiological limitations set up in the plant during growth. For instance, increase in the number of locks per boll results in a reduction of the number of seeds per lock which, in its turn, affects the weight of individual seeds, although all these form components of yield according to Harland's scheme.

In the next chapter, the classification of the cotton varieties is dealt with. The grouping adopted by Harland has been reproduced in detail; but the nomenclature used by Watt, Gammie, Hutchinson and Ghose has also been used in addition, which will cause some confusion in the minds of the casual reader in the identification of cottons referred to in the monograph.

The third chapter describes the breeding methods. It is refreshing to note that emphasis has correctly been laid on the importance of acclimatisation and also on the causes that lead to failures. One wishes, however, that information given under selection is made more complete and up-to-date. Undue importance is given to the method of type selection which is now being superseded by methods which will enable to distinguish genetic variance from that caused by environment. The main objectives in breeding, *viz.*, yield and quality, being quantitative in performance, description of methods useful in the evolution of stability in such characters will prove profitable to the workers. It is now recognised that methods like the replicated family block method, dealt by Hutchinson and Panse, will reduce much of the personal element generally associated with the type selection method.

The chapter on propagation and conservation of cotton varieties gives a complete and lucid picture of the steps taken in Egypt and U.S.A. to maintain pure seed supply and will, therefore, prove very instructive to all interested in cotton improvement. This is followed by an interesting contribution on the trends of improvement in the chief cotton-growing countries of the world. Too much space is, however, devoted to the enumeration of the various commercial varieties found in India which is not completely relevant to indicate the trend of improvement.

A fairly good list of literature is appended at the end, although a few recent publications like those on plant breeding technique by J. B. Hutchinson and his collaborators, are being missed.

On the whole, this booklet will form a useful addition to the list of references on cotton breeding. V. R.

A Text-Book of Thermodynamics. By F. E. Hoare. II Edition. (Edward Arnold & Co., London), 1938. Pp. 307 + xii. Price 15*sh*.

"There appear to be, however, few books showing the variety of subjects to which thermodynamics can be applied, and it was in the hope of remedying this deficiency that this book was written." In the second edition, certain portions of the book have been revised; the notation has been altered in accordance with the recommendations made by the Joint Committee of the Chemical, Faraday and Physical Societies; a collection of examples with answers has been added. These changes have considerably enhanced the usefulness of the book. Exposition is generally clear. One exception, however, is to be found in the treatment of ionic migration (p. 207) which has been discussed without introducing the term "transference number". An introduction to non-ideal solutions with a brief discussion of the modern views regarding strong electrolytes would have been highly useful. Notwithstanding these minor shortcomings, the book serves well as a general introductory treatise on thermodynamics, especially to the physics students. K. S. G. D.

Problems of Power Supply in India. Symposium held under the auspices of the National Academy of Sciences, India. (*Proc. National Academy of Sciences, Special Number*), 1938. Pp. 100. Price Rs. 2 (India), Rs. 2/8 (Foreign).

The desire for self-determination in India has coincided with intense ferment in the minds of the intelligentsia in various directions. No nation can achieve and maintain its freedom without being strong in the sciences of the day—agriculture, industry and defence. In a word, power is the *sine qua non* of Indian freedom. The National Academy of Sciences has drawn attention to

the need of properly harnessing our electrical power resources in its illustrated booklet.

Lenin wrote, in 1920, "without electrification, progress in industry is impossible" and directed two hundred scientists and engineers to plan the restoration of Russian national economy. G. R. Toshniwal describes how this Goelro-plan, in ten years, reconstructed industry with the result that "the Russians are no longer a half-clad and starved nation". Prof. M. N. Saha startles the reader saying that "in the scale of civilization, India comes as low as China or Abyssinia". Consumption of electrical energy *per capita* is 7 units in India as compared with 1,800 units in advanced Western lands. The reason is not that India has no resources but that its governments have not cared enough to investigate or develop them in the interests of the people. A. N. Tandon discloses the unsatisfactory condition of supply of power in the United Provinces. B. P. Adarkar, agreeing with the other writers, stresses the need for beneficent legislation in India to exploit the power resources for the nation's benefit and not for that of foreign monopolists. Prof. Saha points out that the price of power is artificially maintained in India at four times the price in other countries with consequent retardation of industrial development. N. N. Godbole describes how Japan by organisation increased production eightfold in twenty years and by supplying power very cheeply, at one pie per unit, gives an enormous impetus to her industry and trade. Her electrical industry has gradually come under State control, thus co-ordinating her resources just as the Grid-system existing in England and Russia and advocated in India.

N. G. Chatterji has shown that alcohol from molasses of the sugar industry is a cheap and satisfactory fuel for power supply for agricultural purposes.

The general reader will find Appendix A an easy introduction to the discussions and the several interesting tables and data are valuable to the administrator. At the suggestion of the President, Pandit Jawaharlal Nehru, the Academy has passed resolutions asking the State to undertake a vigorous policy for an accurate survey of our power resources, to provide for the training abroad of a number of Indian engineers who are to develop power in India and to pass necessary legislation.

According to Sir M. Visvesvaraya, hardly the fringe of India's Power has been developed and if the national governments plan a bold outline of a unified attempt after the Russian model, there is no reason to doubt that India will rank, in ten years, with the most advanced countries.

The Academy has to be congratulated on its contribution to the National Planning at such an opportune moment. However, reflecting on man's glorious achievements, would one agree with the statement that "man regarded as an animal producing work is rather a poor specimen" (p. 83).

The booklet is neatly printed except for some typographical and idiomatic errors, *e.g.*, on pp. 57, 69, 84, 87 and 90.

Y. K. RAGHUNATHA RAO.

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(1) Milk Records of Cattle in Approved Dairy Farms in India. (Bulletin No. 18), 1938. Pp. 175. Price Rs. 2–12–0 or 4*sh.* 6*d.* **(2) Report on a Village Enquiry Regarding Cattle and the Production and Consumption of Milk in Seven Breeding Tracts of India.** (Bulletin No. 22), 1938. Pp. 127. Price Rs. 3–8–0 or 5*sh.* 6*d.* **(3) The Nutritive Values of Indian Cattle Foods and the Feeding of Animals.** (Bulletin No. 25), 1938. Pp. 39. Price Annas 7 or 8*d.* (Imperial Council of Agricultural Research—Manager of Publications, New Delhi.)

(1) An exceedingly useful publication covering 170 pages, all of which but for the first four pages, is devoted to data running into several tabular forms, has recently been issued. This publication has appeared not a day too soon. Information received from 36 farms is incorporated in these pages.

Short notes on the "conditions of climate, feeding and management" in the various centres mentioned would be a useful addition. To secure uniformity, all dates and years could be according to the British calendar (p. 58, 120). Inclusion of more 'fat tests' by which expression is probably meant fat per cent. would have been welcome.

(2) Another Bulletin (No. 22) also issued by the Imperial Council of Agricultural Research, brings together the most reliable information relating to cattle, and the production and consumption of dairy produce in

the seven breeding tracts of India, comprising 7,600 agricultural holdings. Judging from the quality and the quantity of data presented in this report all of which was collected in a short span of five months, it is an unprecedented success.

Unfortunately it bears the mark of hurried printing. It is surprising that the seven tracts have not been properly indicated in the map and the use of names of provinces in their place in the tables, causes confusion. Such expressions as 'female buffaloes', 'buffalo cows' and 'cow buffaloes' in place of the more usual 'she-buffalo' could have been avoided. The same remark applies to the use of the word 'sweet-meats' to imply 'sweets'. There are a number of other errors which would have been avoided.

(3) Bulletin No. 25 dealing with data relating to results of chemical analysis, digestibility coefficients and the nutritive values of Indian cattle foods with a 14 page introductory note on the scientific principles of feeding of farm animals in general, and of cows in particular is of the nature of a rough and ready guide for the planning of suitable rations for the farm animals. The subject is dealt with in an easily understandable manner and the Bulletin fulfils a real want.

G. N.

Theorie et Technique du Bruit de Fond (Effets Schottky et thermique). By F. Bedeau. (Actualites Scientifiques et Industrielles, No. 574). Hermann et Cie, Paris), 1937. Pp. 95. Price 25 *fr.*

This is a clear exposition of the theoretical and practical aspects of two of the phenomena which give rise to the background noise in a radio receiver. One of these is the fact that the number of electrons emitted from the filament of a valve in short equal intervals of time fluctuates (Schottky effect). The other is the fluctuations in the velocity of the conduction electrons in any resistance due to thermal agitation, giving rise to fluctuating voltages at its ends (thermal effect). These effects play an important part in the performance of a wireless receiver and the book is worth perusing by any one interested in the working of an apparatus which has nowadays become a common article of household furniture.

T. S. S.

Travaux Pratiques de Physique—1. Mesures, Chaleur. Par Maurice Prost. (Actualités Scientifiques et Industrielles, No. 628. Hermann et Cie, Paris), 1938. Pp. 93. Price 25 *fr.*

The volume gives in clear and concise language, the practical methods in a few select elementary problems in metrology and heat. The subjects dealt with are the precision balance, calipers, screw gauge and spherometer, densities of liquids and solids, simple and torsional pendulums, barometry, thermometry and calorimetry, pressure and density of vapours, and cryoscopy, viscometry and capillarity.

C. S. V.

Intermediate Physics, Part I (Mechanics). By Prof. D. S. Jog, M.Sc. (Karnataka Publishing House, Bombay), 1938. Pp. xi + 334.

This book has been written to cover the latest syllabi in Mechanics of the I.Sc. standard. Portions above this standard have been included, these being differentiated from the rest by printing them in small type. The fundamentals of the subject are carefully developed and well expounded.

Although one may deviate from the usual methods of treatment, the reviewer cannot see eye to eye with the author in the intermingling of the two parts Dynamics and Statics, as has been done by him. The experimental aspects of the subjects could have been more profitably enlarged by cutting out short portions not required for the I.Sc. course. Topics like comparison of Masses with the Hick's Ballistic Balance, experiments with the inclined plane and the use of steel yards have not been mentioned at all. On page 39, under measurement of Mass, the reader is referred to Chapter XIV for the theory of the balance. In Chapter XIV, the theory of the balance has been dealt with, while the student is asked to refer to some text-book of Practical Physics for full details for the method of determining the mass of a body by the method of oscillations.

One important and welcome feature of the book is the inclusion of some biographical notes on prominent physicists with their portraits. The book will be of very great use to every serious student and teacher of Physics.

K. Srinivasa Raghavan.

Laboratory Experiments in Elementary Physics. By Newton Henry Black. (Macmillan & Co., New York), 1938. Pp. 263. Price 5/6.

This book is offered as a guide to both student and instructor in the Laboratory work. Sixty-two experiments have been dealt with on various branches of Physics. Descriptions of apparatus to be used have been avoided by introducing photographs of the apparatus themselves. The Introduction, covering about seven pages, contains suggestions to teachers and directions to students, particularly with regard to the latter's record note-books, percentage of error, the care of the apparatus and the like.

One important feature of the book is the fact that a number of questions have been given under each experiment by answering which students could draw conclusions from their own experimental data. The Appendix contains a tabulated statement of a number of physical constants with necessary mathematical formulas and with hints about graphical representation of the results of experiments.

The book can be advantageously recommended as a good guide to accompany Black & Davis' *Elementary Practical Physics*.

K. SRINIVASA RAGHAVAN.

Adhunika Vignanam (Modern Science). By M. Venkata Rao, Vizianagaram. (Sarada & Co., Vizianagaram), 1938, Pp. 50. Price 6 annas.

This is a pamphlet containing a reprint of three popular Science articles in Telugu, first published by the author in some Telugu journals. The first article on 'The Mystery of the Creation' deals with the constitution of the planets and the stars and gives a side-talk on the theory of light, the wireless, radio-activity, television and the airship. The second article is on 'Mantras' in which the author tries to explain their efficacy scientifically in an ingenious manner taking for his help, gravitation, magnetic action, ultra-violet rays and ultra-sonics. The third article is on 'Voyage to the Moon' in which the author describes the phases of the moon, its constitution, the nature of its atmosphere, its gravitational attraction, etc.

The mode of presentation of each of these subjects is very attractive. It is in the form of dialogue between a student of Modern Science, not altogether an unbeliever in the old orthodoxy and an out and out orthodox person who believes that there is nothing new beyond what is contained in the Vedas, the Sastras and the Puranas, and who has little respect for Modern Science.

The language is completely non-technical and colloquial and the style very elegant. Tracts like these dealing with the various scientific subjects ought to be published throughout India in the several languages, in hundreds, solely with a view to create an interest in the people for Modern Science, and as a preliminary to the spread of scientific education.

B. V.

Philosophic Activity in the West.
(1) Actualités Scientifiques et Industrielles, No. 575, 1937. Pp. 21. Price 5 *fr.*;
(2) No. 527, 1937. Pp. 54. Price 12 *fr.*;
(3) No. 572, 1937. Pp. 53. Price 15 *fr.*;
(4) No. 573, 1937. Pp. 62. Price 18 *fr.*;
(5) No. 546, 1937. Pp. 35. Price 10 *fr.*;
(6) No. 592, 1938. Pp. 88. Price 20 *fr.*

The Pamphlets issued under the general series "Actualites Scientifiques et Industrielles" heading bear eloquent testimony to the intensity of the philosophic activity in the West directed to the interpretation of theoretical patterns of thought in relation to practical concerns of life to the extent to which such correlation may at all be possible. The *first* pamphlet deals with the "Actuality of the Platovian Problems", and as some other studies in the series unmistakably indicate, it is obvious that Plato and Aristotle continue to inspire quite a large number of philosophical and critical studies. The *second* has for its subject-matter the "Critique of Measure", and the author discusses the antinomy about Measure. The *third* contains a discussion of the problem of knowledge with reference to Empiricism and Greek Rationalism. The *fourth* is devoted to a study of "Plato and Aristotle". The *fifth* has an "Essay on Two Hypotheses of Parmenides". The *sixth* examines the nature of the "Language of Sciences".

I do not believe it would be possible, within the limits of this notice, to do justice to the contributions made by different authors to specific branches of knowledge, but, some general observations may be quite in order. The pamphlets embody results of investigations pursued from time to time,

and though the results achieved cannot claim permanent and universal validity, they serve to stimulate thought and kindle critical investigation.

Plato and Aristotle still continue to offer the modern world, as it were, many persistent problems of philosophy and it is here just where philosophic speculation or system-building gives rise to more problems than it ever finds itself able to solve, there is the battleground of fight between laboratory science, with its apotheosis of quantitative precision and verification, and metaphysics proper, the concepts of which elude the grasp of laboratory methodology.

The pamphlet on "Parmenides" discusses a highly significant problem of ancient Greek speculation, and though no final solution is ever possible in the nature of the case, the author has focussed attention on the basic concept of the Eleatic system systematized by Parmenides. In Indian Philosophy of course, the problem of the One-and-the-many is as alive and dynamic to-day as it must have been centuries ago when Sri Sankara sternly and courageously championed his monistic interpretation of the Vedanta.

The pamphlet on "The Language of the Sciences" raises important questions concerning the terminology adopted by different sciences, and it must, however, be emphasized that the nature of the reality or subject-matter dealt with largely determines the language used. Certain familiar concepts of religion, philosophy and theology do not lend themselves to be translated into the language of the laboratory sciences.

The pamphlets on Plato and Aristotle and the specific Platovian problem consider what I have described permanent problem of Greek Thought which has moulded and directed European Thought at its best. The comment that European Philosophy largely consists in a periodical (conscious or unconscious) forgetting of the conclusions of Plato and Aristotle and their subsequent discovery or re-discovery, may or may not be quite just, but, it represents pretty fairly a true state of affairs. If we keep aside those systems of philosophy which have agreed readily to embark on a career of self-repudiation or self-stultification in order to come to terms with laboratory sciences, others even to-day are obliged to discuss the problems of Plato and Aristotle. Such a state, however, does not detract from modern philosophic endeavour. It only demonstrates the fact that masterminds like Plato and Aristotle had been blessed with the uncanny gift of a correct perception of the basic problems of philosophy every attempted solution of which only acts as a sharp stimulus to further problems.

The pamphlet on "Theory of Knowledge" in reference to the Empiricism and Rationalism of Greek Thought again in its methodology and attempted solution would remind one only of old wine in new bottles, notwithstanding any Governmental or mental campaign in the direction of fractional or total prohibition. In making this remark, however, I do not mean any disparagement to the excellent effort of the author. The problem of knowledge is also the problem of ignorance. Therein lies the rationale of the fruit of the forbidden tree!

The six pamphlets briefly noticed here, dealing with a variety of subjects indicate how intense and sustained are philosophic activity and metaphysical endeavour in the West. Whether or not one agrees with the conclusions arrived at by different writers, it is impossible to withold tribute and gratitude to them for the systematic manner in which they pursue philosophic quest—a quest which is not in most cases accompanied by quick-returns in the shape of the currency of the land.

R. NAGA RAJA SARMA.

Publications du Laboratoire D'Essais XXIX. Les Cristaux Mixtes et Leur Structure. Par Pieere Dubois. (Actualités Scientifiques et Industrielles, No. 627. Hermann et Cie, Paris), 1938. Pp. 42. Price 12 *fr.*

A brief resumé of the formation of mixed crystals of insertion and of substitution having the same lattice as one of the constituents, as well as those having a lattice different from those of either of the constituents is given. Their significance in relation to the problem of isomorphism is discussed.

C. S. V.

Fishing Methods of the Malabar Coast

MR. JAMES HORNELL, formerly Director of Fisheries, Madras, has recently published the second part of his account of "The Fishing Methods of the Madras Presidency"[1] in which he describes the fishing craft and methods of fishing employed on the Malabar Coast. The first part of this series, it may be recalled, appeared in 1924 and was devoted to the fishing methods of the Coromandel Coast.

The geographical limits of the Malabar Coast are slightly extended to a total distance of more than four hundred miles on ethnological grounds. The area thus defined is divided into three separate sections—a southern, a median and a northern—according to the distinctive types of fishing craft and methods. The southern section is called the Catamaran coast, as the fishermen here use the same type of Catamaran as is used by the fishing communities on the western coast of the Gulf of Manaar; their fishing methods are also closely related, the only difference being the use of a primitive trawl (*Kurukku Made*), which is described in detail, by the former. The median section comprises the coastal region dominated by Malayalees, who use dugout canoes and employ totally different methods of fishing. The northern and last section is coincident with the entire coastline of the South Kanara District. Here the dugout canoes are used for inshore and backwater fishing, and plank-built boats for offshore fishing. The methods used in the last two sections are either similar or differ in minor details, and the author has, therefore, dealt with the fishing methods of both the sections together.

The methods and implements of fishing are different for different types of waters, such as backwaters, estuaries and the sea. The various methods and implements used in these waters are described in detail, and illustrations and vernacular names are given so far as possible.

The paper is of additional importance on account of the ethnological information embodied in it. According to the author some of the implements are not indigenous, but had been introduced during the time of early influence of the Europeans on the Malabar Coast. For instance, the South Indian Cross Bow, in common with that of West Africa, is undoubtedly of European origin. The author supports this hypothesis on two considerations, namely, its vernacular name and the character of its release. The Malayalam name of the Cross Bow is 'Parangi pathi'. 'Parangi' is the Dravidian corruption of 'ferringhi' or Frank; this term in later times has come to be accepted as the virtual equivalent of Portuguese and hence the association of this weapon with the Portuguese. The details of the release are identical with those of the typical mediæval Cross Bow used in Europe in the sixteenth century. Similarly, from the vernacular name of the Chinese Balanced Dip-net used exclusively near Cochin, it is generally assumed to be an introduction from China, as are several other items in the material culture of Malabar. The author is however, against the theory of its direct introduction by the Chinese, who were undoubtedly trading with India prior to the arrival of the Portuguese, for, the technical terms in use in Cochin for the principal parts of this complicated implement are of Portuguese derivation. Cochin being their chief settlement on the Malabar Coast, the Portuguese might have introduced this effective dip-net after noting how the Chinese use it with great advantage and skill. Another rather unusual fishing method is the one in which a sickle is used; according to Hornell, the use of this agricultural implement in fishing outside India is only known from the Channel Islands and the northern coast of France.

Another very useful feature of the paper is the large number of beautiful photographs illustrating the life and methods of fishing of the people of the Malabar Coast.

K. K. NAIR.

[1] *Madras Fisheries Bulletin*, 1938, No. 27, pp. 1–69; 21 text-figures, 11 plates.

INDUSTRIAL SECTION

Stainless Steels*

IN the courtyard of a mosque near Delhi, there stands an iron pillar nearly 24 feet high, 15¼ in. in diameter and weighing about six tons, which was erected about A.D. 300. It is very interesting to know that the Indian craftsmen of that day were able to fashion so large a piece of iron at a time when all other peoples then, and for centuries later, could only forge iron in the form of small pieces for use as weapons, tools and household appliances. *Still more remarkable is the fact that that pillar has withstood the ravages of time and atmospheric corrosion up to the present day.*

Since the days when that pillar was set up, the metallurgy of iron has made enormous strides. The invention of blast furnaces and the art of steel making, the development of rolling mills, steam hammers and hydraulic forging presses, aided by scientific investigation of the physical and chemical properties of iron and steel have, so to speak, changed the face of the earth. But for all that the problem of protecting iron and its alloys from the weather, and from attack by chemical agents was not solved until about thirty years ago, at a time when the iron and steel industry had already attained a remarkably high state of efficiency.

In the year 1909, the metallurgical engineers of the Krupp Works were conducting experiments in search of a heat-resisting steel suitable for Pyrometer sheaths. The experimental melts made by them contained chromium in varying amounts. These alloy steels proved satisfactory in respect to scale resistance at elevated temperatures, but at the same time it was perceived that some of the alloys tested remained perfectly bright for months in the highly corrosive atmosphere of the laboratory. That was indeed a turning point! There in the metallurgists' hands was the very first iron alloy capable of resisting intense chemical attack!!

Systematic scientific investigation of these alloys was forthwith organised, one of the main objects being to develop methods of heat-treatment that would render these then extremely hard metals amenable to shaping and machining processes.

When these problems were successfully solved, the Company's Metallurgists devoted themselves to the task of improving the methods of fabricating these valuable metals so as to enlarge their sphere of usefulness. The technique of welding, in particular, was brought to a high state of perfection, so that to-day rustless steel plant up to the largest sizes can be built up by welding at site.

The great variety of working conditions which rustless steel is required to meet, led to the evolution of a number of different types of this metal, and in addition to two corrosion-resisting alloys, the most important of these being the VA and VM groups. The various groups differ from each other in chemical composition and physical properties. Their chief characteristics are:—

The 'VA' Group

Composition: (*a*) About 18 per cent. chromium and 8 per cent nickel, with a low carbon content. (*b*) Other ratios of chromium to nickel, to which are sometimes added other alloying elements.

They possess an austenitic structure and are non-magnetic. They are not hardenable by quenching, and are available with tensile strengths varying from 35 to 48 tons per square inch.

For this group, generally speaking, the differences in tensile strength existing between the various types is of less importance than other considerations such as corrosion resistance and easy workability. These steels are the most important as far as the chemical industry is concerned. In addition to possessing the highest corrosion and acid-resisting properties of all steels, they are comparatively easily workable, as they possess good deep drawing qualities and are easily welded. Up to a comparatively short time ago, it was necessary to heat-treat all

* From a paper read by Mr. K. N. Prahlada Rao, B.Sc. (Met.), of Messrs. Krupp Indian Trading Co., Ballard Estate, Bombay, at a Symposium on "Materials of Construction in the Chemical Industry" held at Bhadravati, under the joint auspices of the Association of Technologists, Mysore, and Technological Association, Bahdravati, on April 7, 1939.

stainless steels after welding in order to restore their corrosion-resisting properties, which were affected by the welding process. In the case of larger parts, which could not be easily treated, this was a serious disadvantage. Now this disadvantage has been overcome and types are available that do not require any heat-treatment after welding.

Of all corrosion-resisting steels and alloys, the "VA" Group offers the widest field of application. Even at higher temperatures they are absolutely resistant to corrosion by numerous organic and inorganic acids, bases and salts. They are indispensable in up-to-date plants for the production of nitric acid, artificial fertilisers, explosives, artificial silk, photographic films, dyestuffs, oils, soap, paper and textile goods. They are widely used in breweries and distilleries, and in the dairy and foodstuffs industries.

The 'VM' Group

The next group to be considered is known by the designation "VM". The steels in this group have a composition of from 12 to about 18 per cent. chromium, with varying carbon contents. They possess a Troostito-martensitic structure, and are magnetic. That they are hardenable by heat-treatment gives them a special value for certain applications, where this property is essential. The tensile properties can be varied by heat-treatment to meet specific requirements. In the heat-treated state, owing chiefly to a difference in carbon content, their tensile strengths range from 41 up to 102 tons per square inch.

The development of the "VM" steels is a triumph of the Metallurgists' endeavours to make stainless steels with greatly varying tensile strengths to meet the needs of an immense number of different types of industrial plant. They are primarily intended for use as constructional steels for general engineering purposes and similar applications, but not for welded work. There are special types suitable for parts subject to heavy mechanical stresses, as, for instance, shafts, piston rods, valve stems and seats, turbine blading, ships' propellers, etc.

Another type has been developed to meet those cases where a high degree of hardness up to 530 Brinell is essential, *e.g.*, machine knives, plungers, measuring instruments, ball and rollers for bearings, etc.

The "VM" Group of steels depends to a considerable extent on heat-treatment and surface finish for its corrosion-resisting properties. Provided these are given the necessary attention, excellent results are obtained.

The 'VF' Group

The next type of steels to be considered lie within what is known as the "VF" Group. These contain over 12 per cent. chromium with a very low carbon content. They have a ferritic structure and are magnetic. They are not hardenable by heat-treatment. As they have a ferritic structure, heat-treatment produces no change in the structure of the steels, or at the best a partial change only. It follows, therefore, that heat-treatment cannot modify the mechanical properties of these steels to any appreciable degree. The most widely used types have a tensile strength of from 35 to 41 tons per square inch. They are used for constructional purposes in cases where the parts are not subject to severe mechanical stresses. Corrosion resistance is about equal to that of the steels in the "VM" Group. As they are somewhat cheaper than the steels of the latter group, they are used instead of that material wherever possible. They have not found extensive employment in the fabrication of chemical plant because the weldability is rather limited. Nevertheless, when selected for suitable purposes, they give excellent results and immunity from corrosion.

Nirostaguss Alloy

Under Group IV, is included the "Nirostaguss" alloy. This contains over 24 per cent. chromium, from 1 to 2 per cent. carbon and dependent on the use to which it is to be put, with or without an addition of nickel and/or molybdenum. The alloy is a ferrito-ledeburitic or austenitic structure according to the nickel content. The magnetic properties are also dependent on the composition as stated before.

"Nirostaguss" resembles cast iron inasmuch as it shows no elongation to speak of, and is also rather sensitive to shock. The tensile strength of "Nirostaguss" is about twice that of ordinary gray iron. The alloys are immune from attack by numerous chemicals. They are useful substitutes for casting purposes in such cases where steels of the "VA" Group are not absolutely indispensable, or where such steels cannot be

employed on the grounds of founding technique. They are used especially in the nitric acid industry and pulp industry; furthermore, for drying cylinders for the paper industry, etc.

Thermisilid Group

The last group of stainless alloys to be dealt with is known as "Thermisilid". This is actually a high silicon cast iron, which is remarkable for its excellent resistance to many kinds of corrosive attack. The material is produced by a special founding process. These alloys resist attack by a number of corrosive agents against which alloy steels proper are not proof. Unfortunately, their sphere of usefulness is limited by a certain lack of ductility, owing to which their employment is restricted to such parts of chemical plant as are not subject to severe mechanical stresses. For all that, and particularly if suitable protection against shock is provided, the "Thermisilid" alloys may be employed to great advantage in the form of apparatus, piping and fittings in acid manufacturing plants, explosive factories, dye works, pickling plants and many other kinds of chemical works.

Heat-resisting Alloys

Heat-resisting alloys which are in many ways related to the stainless alloys and which also serve many useful purposes in the chemical and allied industries have been developed to meet a number of requirements. The most essential of these being:—

(1) Corrosion resistance particularly at elevated temperatures. Under this head comes scale-resistance, by which term is understood immunity to oxidation at high temperatures, and also resistance to attack by sulphurous gases and similar corrosive media. (2) Retention of mechanical strength and shape at elevated temperatures. (3) Retention of mechanical properties in repeated heating and cooling operations. (4) Special physical properties. A further important requirement is good ductility.

As regards the economic aspect of the use of heat-resisting alloys, it can be stated as a general rule that a saving in production cost is effected not only through increased length of service of plant, but also owing to certain incidental factors such as reduction in weight and resultant fuel economy, less idle time of plant due to repairs, replacements, etc.

In comparison with ceramic refractory materials, the better thermal conductivity of the heat-resisting alloys, their greater toughness and resistance to blows and shocks, as well as the possibility they offer of repairing fractured parts, are distinct advantages.

The advent of heat-resisting alloys has solved many baffling problems of metallurgical and chemical equipment design.

Two essentially different types are produced. The first of these have an austenitic structure and the second have a semi-ferritic or entirely ferritic structure. The service temperatures at which they can be safely employed vary from 800° C. up to 1300° C. Generally speaking, their most important features are the corrosion resistance at elevated temperatures and tensile properties and retention of strength at elevated temperatures.

For many years, the heat-resisting steels have been put to numberless uses in the chemical industry, for example for annealing tubes and muffles, protective sheaths, crucibles, retorts, rabbles for roasting furnaces in various industries, *e.g.*, sulphuric acid manufacture, apparatus and conduits for hydrogenation processes, etc. They have also been extensively used in the enamelling trade, engine construction, furnace construction, porcelain and ceramic industries, and so on.

The discovery of rustless steels and alloys, and heat-resisting alloys, is one of the outstanding achievements of the human mind. Numerous chemical processes are indebted to these materials for their practical application on a manufacturing scale, while a still greater number of others have been placed on a far sounder economic basis than formerly by the use of a plant made of them. For a great variety of other purposes, the application of stainless steels ensures spotless cleanliness and the acme of sanitary perfection. It will certainly not be long before this excellent metal is used to the exclusion of all others for hospital, hotel, restaurant, and even private household utensils, fittings and appliances, with the result that this really epoch-making invention, which has already had such a far-reaching influence on industry, will eventually confer its benefits upon human society at large.

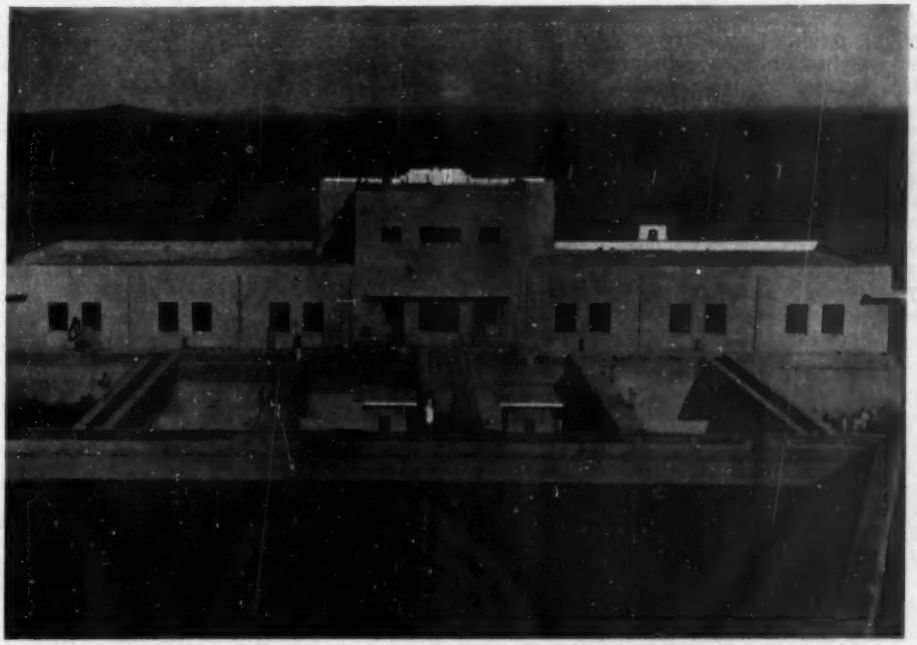
Indore City Filtration Plant

By Rao Bahadur B. L. Modak, M.C.E.

(*Executive Engineer in charge of Indore City Water Supply*)

THE purification plant is a modern Rapid Gravity Filter Plant.

The capacity as constructed is six million gallons per day, but equipment has been provided at present for only four million gallons per day. The ultimate capacity of the plant will be eight million gallons per day.



The plant includes:—

(*a*) Dosage of Coagulants.
(*b*) Mechanical mixing of Coagulants.
(*c*) Odour Control.
(*d*) Aeration.
(*e*) Aggregating Tanks.
(*f*) Settling Tanks.
(*g*) Sludge Removing Equipment.
(*h*) Filters.
(*i*) Sterilizing Plant—Chloramine Process.
(*j*) Corrosion Control.

Coagulants

Provision has been made for the addition of any or all of the following chemicals:—alumina, sodium aluminate, soda ash and lime. This flexibility will enable any condition of the raw water to be treated efficiently and economically.

Alumina, sodium aluminate and soda ash would be proportioned and added in solution form, while lime would be controlled by a Dry Chemical Feeder.

Mechanical Mixing of Coagulants

The most efficient use is made of the coagulants by proper mixing after addition to the water. This is done by means of two Flash Mixers arranged on the inlet to the Aggregating Tanks.

Odour Control

The removal of unpleasant odours from the water when they occur, will be carried out by the addition of powdered activated carbon which absorbs the odour-producing substances, usually oils from decaying animals and vegetable organisms. The powder

is added before the filters and is removed with the adsorbed oils in the filters.

The action of the carbon is assisted by aeration of the water prior to settlement.

Aeration

At certain seasons the water is known to contain iron, and aeration is provided to deal with this impurity. Besides oxidation of the iron, aeration materially assists in coagulation and odour removal. The aeration is provided in two chambers into which compressed air is blown.

Aggregating Tanks

After the addition of the coagulants and adequate mixing, the water is brought to the aggregating tanks, or primary settling tanks, in which the flocculent particles are conditioned to increase their size and density, making them fall more quickly in the Settling Tanks. This is effected by contact between the sludge already formed in the bottom of the tanks and the incoming water. This contact enables the necessary chemical reactions to go rapidly to completion and the controlled agitation provided by a 'snow balling' action, increases the density and size of the particles.

Settling Tanks

The settling tanks are of the horizontal flow type which are found very efficient in dealing with an adequately 'conditioned' water. They are designed to give a steady and even flow with the minimum of eddying to water passing through them. To this end no baffles are provided but the design of outlet and inlet are such that full use is made of the tanks.

Sludge Removal

Sludge can be removed from both the primary and secondary tanks without interrupting the section of the plant. Both sets of tanks are provided with hopper bottoms which collect the sludge falling from the water in its passage through. These hoppers are designed so that all sludge falls to the bottom of the hopper and is withdrawn by a sludge outlet provided at this point.

This special design eliminates the necessity for putting the tank out of operation for draining down and removal of the sludge by hand.

Filters

The filters are the heart of the plant. All that goes before is conditioning to make the water suitable for filtration.

Each unit is capable of dealing with one million gallons per day. The area of the filter bed is 600 square feet so that the rate of filtration is 1,666 gallons per square foot per day, or 69·4 gallons per square foot per hour. Four units are fully equipped and the masonry work for six has been completed.

All filter controls have been centralized so that the whole operation is carried out from the control platform in front of the filter. These controls are mounted on a table and the opening and closing of the valves, starting and stopping of motors are carried out merely by turning levers or pushing buttons. Also on this table are indicators consisting of dials and signal lights which tell the operator exactly what is happening and record on a chart the rate of flow and the loss of head through the filter.

Power for the operation of the valves is provided from a central hydraulic accumulator with automatic pressure control to the high pressure booster pumps. The valve position indicators are operated by "Teleflex" cables. The signal lights are electrically operated from each control table and there is a master panel in the main office giving a complete indication of the working of the plant to the Supervisor. The starting and stopping of the motors is arranged for push button control from the control table with automatic starters by the motors.

The cleaning of the filter beds is carried out by a new and highly efficient method. Compressed air and water are used, as is usual with other systems but these are arranged for simultaneous application. In addition the patent 'Surface Flush' of the bed after cleaning is incorporated and this enables all dirty water on the bed to be removed from the top of the filter before it is again put into service.

The result of this modern system of filter cleaning is that the filters are kept in an exceptionally clean condition, consistent with efficient filtration, and the consumption of power and wash water is reduced to a minimum.

The flow of water through each unit is controlled by a 'Modern' and a 'Slow Start'. The former controls the rate of flow during normal working while the latter automatically shuts and opens the module before and after cleaning. The opening of the filter after washing has to be done slowly and gradually to ensure that the effluent is

always up to standard. This is not the case if the unit is put into operation immediately after washing at the full rate.

The provision of these modern and automatic units makes for greater efficiency and lower running costs. The case of carrying out the washing operations means that the units are out to operation for a much shorter time and therefore the nett filtering capacity is increased.

The recording instruments provided enable an infallible check to be kept on the performance of the plant by the responsible officer.

Sterilization

After the filtration the water will be clean and bright and free from all suspended matter. Approximately 95% of all bacteria will have been removed but to ensure that there is no possibility of any harmful bacteria passing into the distribution system, a minute dose of chlorine and ammonia is added to the water.

These chemicals will sterilize the water and will also provide the water with a resistance to after-infection so that any pollution finding its way into the distribution system is counteracted.

Corrosion Control

The action of water on steel and cast iron is often the cause of rapid and costly deterioration of the distribution system. Corrosion is controlled by adjustment of the pH of the water and this will be raised when required by the addition of lime after filtration.

Laboratory

A chemical and bacteriological laboratory is provided and tests are carried out as a matter of routine to ensure that proper purification is taking place.

Softening

A feature of the plant is that provision has been made in the design so that when the ultimate capacity of eight million gallons per day is installed, two million gallons of this can be softened by the Lime Soda Ash process. This was done as it was felt that a softened supply would be appreciated by the mills and other industrial concerns in Indore.

General

The plant was designed by the author with the assistance of Candy Filters (India) Ltd., water purification specialists. All equipment was provided by this firm.

India's Forest Pests

THE biological data collected at the Forest Research Institute, Dehra Dun, after years of research and now made available to the public in a recent publication in the *Indian Forest Records* (new series) Entomology, have been found to be of great assistance in organising a fight against the numberless pests which cause enormous losses to India's forest wealth.

The average annual loss due to the sal borer, for instance, in Government forests alone is not less than Rs. 2,50,000, while in epidemics the loss may rise to enormous proportions.

In a small epidemic affecting eight square miles of forest in the United Provinces, 45,000 trees with timber content of nearly a million cubic feet, were killed with a loss of Rs. 2,70,000.

The most serious epidemic on record was one which affected five forest divisions of the Central Provinces, an Indian State and extensive private land. When remedial measures were taken, it was found that, on 150,000 acres of sal forest in two divisions, timber, valued at about Rs. 7,50,000 had been destroyed. In the following year the attack extended to 5,500,000 trees in this area, with a loss of forest capital of nearly Rs. 1,37,50,000. Before the epidemic was checked, the total number of trees attacked over the whole infested area rose to 7,000,000. Four years of control operations and an expenditure of Rs. 1,25,800 were necessary, before the epidemic was definitely overcome.

Particularly injurious to avenue and shade trees planted in towns and along roads, especially willows and poplars, is a pest called *Æolesthes sarta*. It also works damage in fruit orchards. The avenue and garden trees of Quetta were severely attacked by this borer in 1904–06, necessitating the felling of some 5,000 trees. Over 20,000 beetles were collected and destroyed in 1905 and 3,000 in 1906.

Another beetle (*Chlorophorus strobilicola*) which attacks the cones of pines from altitudes of 2,000 feet to 6,500 feet, is the commonest in open sunny stands of chir pine. The damage done is almost negligible in a good seed year, but when cones are few the proportion infested may rise to even as high as 40 per cent.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Saunderson, Nicholas (1682–1739)

NICHOLAS SAUNDERSON, a blind British mathematician, was born at Thurston in Yorkshire, January 1682. He became blind from smallpox at the age of twelve months. In spite of it he attended the free school at Penniston and learnt the rudiments of Greek and Latin. His father, who was an excise man, soon observed the predilection of his son for mathematics and taught him the elements of arithmetic. Two friends perceived the remarkable talent of this blind youth and taught him algebra and geometry. By the help of a retentive memory and the power of his genius, Saunderson discovered methods of investigating problems of considerable intricacy.

As Professor

He went to Cambridge in 1707 and began to teach mathematics at Christ's College. Newton's *Principia* was one of the books he taught and he had many students. The peculiar circumstance of his career brought him into friendship with Sir Isac Newton and other prominent mathematicians. When the Lucasian professorship of mathematics fell vacant in 1711, Queen Anne conferred on him the degree of M.A. on the recommendation of Newton and this qualified him to be appointed to that chair. He used to lecture seven or eight hours a day. When George II visited the University in 1728, Saunderson was, by royal authority, made Doctor of Laws.

His Publications

The lectures which he composed for class use were published posthumously. One was the *Elements of algebra*. It came out in two volumes in 1740. Another on fluxions including a commentary on Newton's *Principia* came out in 1756. The first book contains a description of a mechanical device invented by Saunderson to facilitate computation by the blind.

A Psychological Curio

Lord Chesterfield who had attended his lectures described him as a professor who had not the use of his own eyes, but taught others to use theirs. His sense of touch was so keen that he could distinguish "in a set of roman medals the genuine from the false, though they had .... deceived a connoisseur who had judged by the eye". His ideas of the forms which plane or solid figures would assume in different perspectives were said to be remarkably correct. The remarkable achievement of this blind man stimulated a good deal of speculation along psychological lines. Dr. Reid devoted a portion of his *Inquiry into the human mind* to a discussion of Saunderson's powers. Burke also devoted about a page to him in discussing "words which do not raise images" in his *On the sublime and the beautiful*.

Saunderson died April 19, 1739.

Wood, James (1760–1839)

JAMES WOOD, a British mathematician, was born at Turton in Lancashire December 14, 1760. His father, who was a weaver, himself taught arithmetic and algebra to his son. In 1778 he joined St. John's, Cambridge, as sizar. He steadily worked his way until he became a senior wrangler. He became master of his college in 1815 and Vice-Chancellor in 1816. He resided in the college for about sixty years and when he died he had bequeathed his library and about £50,000 to his college. A statue was erected in the anti-chapel.

His Publications

Wood's works were for many years standard treatises. His *Elements of algebra* which came out in 1795, went through several editions and held the field for nearly a century. As late as 1892 an Indian edition of the same was published by P. Ghosh "Remodelled simplified .... with numerous exercises, examples, and Calcutta, Bombay and Madras University examination papers". The *Principles of mechanics* (1796) was a popular text-book till late in the nineteenth century. So also was the case with his *Elements of optics* (1798). Wood was a fellow of the Royal Society and wrote a paper on the *Roots of equations* (1798) to its *Philosophical transactions*.

Wood died in college April 23, 1839.

Burrill, Thomas Jonathan (1839–1916)

THOMAS JONATHAN BURRILL, an American botanist and microscopist, was born on a farm near Pittsfield, Mass., April 25, 1839. While still a child he was sent to work in a cotton mill. Later in 1862, he was sent to the Illinois State Normal School, where the museum of the State Natural Historical Society attracted his attention. The entomologist and the botanist of the museum took interest in him and guided him in his studies. He graduated in 1865 and three years later entered the staff of the University of Illinois.

Publications

He soon conducted a natural history survey of the State and in 1869 he began a series of contributions to the learned organs of his State which he continued with vigour and precision right upto 1915, the articles numbering as many as eighty-two. He was for nearly half-a-century the moving spirit in all the natural history activities of Illinois.

Microscopy and Bacteriology

Burrill was among the pioneers of microscopy in America. In 1877 he announced his suspicion that the terrible epidemic of "fire-blight" of pears was caused by bacteria, which had previously been supposed to cause disease only

in animals. His views were received with scorn in Europe but by 1880 his intensive microscopical investigations and his inducement of the disease in healthy pears by inoculation confirmed his announcement as beyond all scorn and doubt. His prediction that many mysterious diseases such as mosaic blight would prove to be bacterial had been later confirmed. His pathological investigations included such important crop diseases as ear rot of corn, potato scab, blackberry rust, peach yellows and bitter of apples. His last work was an attempt to cultivate the beneficial bacteria of the soil.

Burrill died April 14, 1916.

ASTRONOMICAL NOTES

A Lunar Eclipse.—On May 3, will occur a total eclipse of the moon, visible in India. The circumstances of the eclipse are as follows:

Moon enters umbra	6^h	58^m	p.m.
Beginning of total eclipse	8	10	„
Middle of eclipse	8	41	„
End of total eclipse	9	13	„
Moon leaves umbra	10	25	„

The times are given in Indian Standard Time. The magnitude of the eclipse is 1·182, taking the moon's diameter as unit.

Planets during May 1939.—Both Mercury and Venus will continue to be visible as morning stars; the former reaches greatest western elongation (26° 55′) on May 1. Venus is slowly getting closer to the sun and becoming fainter. On May 17, the planet will be in conjunction with Saturn. Mars which will be on the meridian about an hour and a half before sunrise, is favourably situated for observation during the late hours of the night. It is getting brighter, the stellar magnitude increasing from −0·2 to −1·1 in the course of the month.

The major planets Jupiter and Saturn will also be visible as morning stars. The ring eclipse of Saturn is gradually widening the angular dimensions of the major and minor axes being 36″·7 and 9″·0 respectively. Uranus will be in conjunction with the Sun on May 9.

Comets.—Information has been received (U.A.I. Circular 752) of the discovery of a periodic comet by Vaisala on March 14, in the constellation Leo. The object was diffuse without central condensation or nucleus, and very faint, of magnitude 15. The period is stated to be approximately ten years.

It is announced that Jeffers at the Lick Observatory, has re-discovered comet Pons-Winnecke on March 17, very near the computed position. At the time, it was a faint object, moving in a north-easterly direction in the constellation Bootes. The ephemeris indicates that the comet will increase considerably in brightness in April and May. At the last apparition it was bright enough to be visible with the naked eye for a number of days.

Comet Kozik-Peltier (1939 a) has been well observed. It has now moved far south and become very faint.

T. P. B.

SCIENCE NOTES AND NEWS

Prof. Max Born, Professor of Natural Philosophy, University of Edinburgh, has been elected this year a Fellow of the Royal Society.

Prof. Born is distinguished for his researches in many branches of Mathematical Physics and his recent researches on the New Field Theory have attracted considerable attention. He was associated with the Indian Institute of Science, Bangalore, during the period September 1935–March 1936 as Visiting Professor and during this period he helped to establish a flourishing school of Mathematical Physics at Bangalore.

* * *

Archaeological Finds of considerable importance have been unearthed at the ancient mound of Surkhanvali Ahli near Devanpura in Punjab, as a result of excavations carried out under the leadership of Dr. C. L. Fabri, Field-Director of the Punjab Exploration Fund. Earlier excavations had revealed the remains of an old city belonging to the times of the Moghul Emperors. Further digging resulted in unearthing the remains of a second stratum, some 100–200 years older than the upper level and herein were discovered the remains of a second city, belonging in all probability to the period of Shah Jehan and his predecessors. A large number of antiquities, including household pottery, glass bangles, iron tools, coins, pieces of leather and cloth, etc., have been collected for study.

Further excavations have shown a third stratum, about 9 feet below the second, and here too were found the remains of walls, fireplaces and numerous objects of interest belonging to the earliest period of Muslim rule in the Punjab.

In a letter dated March 30th, received here, Field-Director C. L. Fabri announces that a lower and earlier strata has since been reached. "Yesterday's finds include a potsherd inscribed in early script, certainly much before the arrival of Islamic peoples and it came from the neighbourhood where a terra-cotta head, probably of Buddha, had been found a few days earlier. The site thus fulfils my hopes in being a magnificent collection of successive habitations, such as was badly needed for a proper establishment of Indian Archaeological Chronology".

* * *

Mayan Culture.—The unearthing of a colossal sculptured head of stone and several inscribed monuments, some of the Mayan culture, in a region of Mexico more than a hundred miles outside the previously known "Mayan area" has been announced from the Washington, D.C., headquarters of the National

Geographic Society. The discoveries were made near the village of Tres Zapotes in the State of Vera Cruz by an expedition conducted jointly by the Society and the Smithsonian Institution.

"Significance of the discovery to archæologists", says the announcement, "lies in the fact that science has never before had conclusive evidence that the Mayan civilization extended farther west than a north-south line crossing the western portion of the State of Tabasco at the southern end of the Gulf of Mexico. East and south of this line, in the States of Tabasco, Chiapas, Campeche and Yucatán, Mexico, and in parts of Guatemala, Honduras and British Honduras, are scores of ruined cities and thousands of elaborately carved monuments left by the Maya. These people who have been called 'The Greeks of America,' developed the highest civilization reached in the New World before the arrival of Europeans.

"The only previous indication that Mayan civilization reached farther westward along the Gulf coast was the finding in 1902 of the Tuxtla Statuette, near the city of San Andres Tuxtla, Vera Cruz. This small carved object, now in the National Museum in Washington, bears date in Mayan numerals that has been interpreted as corresponding to 98 B.C. It is thus the oldest dated Mayan object known to exist; but because it is light enough to be easily transported, some archæologists have not been willing to accept the implication that Mayan culture once flourished near San Andres Tuxtla.

"The monuments now being uncovered by the Geographic-Smithsonian Expedition are near and even slightly farther west than San Andres Tuxtla. They are massive and are obviously in the situations in which they were erected. Their discovery not only extends to a considerable distance the known western limits of Mayan cultural influence, but also confirms the significance of the Tuxtla Statuette.

"One of the newly discovered monuments at Tres Zapotes bears a date in the same system of Mayan numerals as those appearing on the Tuxtla Statuette. Although the complete correlation of this date with the corresponding year of the Christian calendar has not been worked out, sufficient progress has been made to determine that the monument was erected during early rather than late Mayan times. So important is the interpretation of this date considered that a number of American and Mexican archæologists have been invited to Tres Zapotes to confer with Matthew W. Stirling of the archæological staff of the Smithsonian Institution, who is in charge of the field work.

"Thirty Mexican labourers are at work daily excavating the plaza, surrounded by mounds, where the colossal head was discovered. Several carved monuments, or stelæ, have been found protruding from the mounds. During the excavations the workmen have uncovered hundreds of pottery figurines of men and animals, and many pieces of broken pottery.

"The colossal head, which was the first object to be unearthed, was found to be nearly six feet high from the base of the neck to the top of the head-dress, and nearly 18 feet in circumference. The largest of the monuments so far discovered is more than 17 feet long and nearly a foot and a half wide. Approximately 30 mounds scattered over a distance of about two miles, have so far been mapped in the Tres Zapotes group."

* * *

The Warkalai Formation in Cochin.—In the course of a communication addressed to us, Mr. T. Sudhakara Menon, Maharaja's College, Ernakulam, reports the occurrence of certain beds in Cochin which bear a close lithological resemblance to the well-known Warkalai formation of Travancore. The laterites with white clay deposits below them similar to those found at Warkalai and Kundara in Travancore, are also seen in Mulanthuruthi, Pulloot, Krishnankotta, Chendamangalam, Karupadanna and other places in Cochin State. Further, several small and isolated lignite beds have also been observed in the "Kole" paddy fields near Kunnamkulam, Enamakkal, Irinjalakuda and other places. These facts show that the Warkalai formation extends into Cochin State also.

This observation is important in view of the fact that Mr. K. K. Sen Gupta in his report on the geology of Cochin definitely asserted that the Warkalai formation does not occur in Cochin State.

* * *

A New Technique for the Measurement of Adsorption of Gases and Vapours on Solids.—Chambers and King (*J. Chem. Soc.*, 1939, p. 139) have described a new technique capable of detecting very small changes of adsorption by a direct reading, floating balance method. The measuring apparatus consists essentially of a Nicholson hydrometer floating in mercury and carrying the adsorbent in the pan. The hydrometer sinks or rises during adsorption or desorption and the level of a reference mark is read with a cathetometer. The great advantage of this apparatus lies in the fact that it combines high sensitiveness and high capacity, so that it is capable of detecting a change of weight of about 1 part in 100,000. The technique seems to be of particular value in the verification of the discontinuities in adsorption isotherm such as have been reported by Allmand and coworkers.

K. S. G. D.

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Fishes of the Genus *Andamia*.—A very valuable contribution to the biology of *Andamia* has been made by H. S. Rao and S. L. Hora in a recent paper by them (*Rec. Ind. Mus.*, 1938, 40, Pt. IV, p. 377). Dr. Hora discusses the systematics of the two species of this genus, *Andamia heteroptera* and *A. raoi*, of which the latter is new. Dr. Rao has studied the ecology and bionomics of the two species. *Andamia* is a little Blennid fish occurring along the Andaman coast and the two species differ in the character of the dorsal spines and anal fins. Each of these further exhibits sexual dimorphism. The fishes occur in their natural habitat clinging to the coastal rocks and move very much like the mud skippers crawling on rock surfaces exposed to wave action. Provided with wide pectoral fins and ventral sucker they are able to maintain their hold on the slippery surfaces. They feed on algæ scraping them off

by their fine teeth. They appear to be capable of a certain amount of aerial respiration.

* * *

Prostomial Glands of the Indian Leech.—The function of the prostomial glands of Gnathobdellid leeches was for a long time obscure and M. L. Bhatia (*Journ. Morph.*, 1939, 64, 37) has conclusively demonstrated that they serve a very important function in the Indian leech, *Hirudinaria granulosa*. The prostomial glands of this leech are unicellular, deeply lying glands. During development, they are seen to arise from the ectoderm though they sink into the deeper layers, later. They are quite distinct from either the salivary or the clitellar glands. The cocoon of this leech is formed by the clitellar glands and is provided with two solid plugs at the two ends. It is the view of the author that the plugs of the cocoon are the products of formation of the prostomial glands. He cites a number of experiments he has conducted by which he has arrived at this conclusion. Leeches from which the prostomium has been severed secrete cocoons which have no plugs and leeches which are disturbed during the act of cocoon formation often withdraw themselves from the cocoon, without forming plugs.

* * *

Microscopic Examination of Cement Clinkers.—The identification of free MgO in cement clinkers is of importance in view of the fact that evidence is accumulating to show that excessive expansion in concrete has been caused by the hydration of crystalline MgO present in it. A satisfactory method for the identification of MgO based on the microscopic examination of polished specimens by reflected light, has just been described (*Instrument Bulletin*, Bausch & Lomb, March 1, 1939). Free MgO observed by this method is found to occur in small angular grains with a reflectivity greater than that of other constituents except C_4AF. Failure, heretofore, to identify free MgO in polished sections was found to be caused by difficulty in proper polishing. Unless polished with extreme care, the edges of the MgO grains are fragmented and secondary scratches beginning from these fragmented areas cover the surface of the specimens. The method for preparing the sections for examination is described in full detail in the Bulletin. MgO can be determined quantitatively in the polished specimens by the use of the integrating stage. Those who are interested in a complete discussion of the microscopical examination of cement are referred to the following publications available from the Superintendent of Documents, Washington, D.C. (U.S.A.):—H. Insley, *J. Res., National Bureau of Standards*, 1936, pp. 917; Insley & McMurdie, Research Paper, 1938, RP 1074.

* * *

Indian Central Cotton Committee.—The problems connected with the present position of cotton and the measures for dealing with them formed the principal subjects of discussion at the meeting of the Indian Central Cotton Committee held on the 31st March 1939, under the Chairmanship of Sir Bryce Burt, Vice-Chairman of the Imperial Council of Agricultural Research and President of the Indian Central Cotton Committee. The Special Sub-Committee which was appointed to examine the matter from all aspects met on March 27th and 28th under the Chairmanship of Sir Chunilal Mehta, Vice-President of the Committee, and its report and recommendations served as the basis of discussion at the main Committee.

In connection with the need for securing better balanced production of different cottons, it was suggested that efforts should be made to obtain fresh breeding material showing variability and combining resistance to drought and disease with good ginning percentage, lint length, etc., from all possible sources including foreign countries, for trial in various tracts.

In order to raise the efficiency of cotton cultivation, the starting in major cotton growing tracts of cotton cultivation projects on complete holdings, or preferably in villages, managed and cultivated by the cultivators themselves, according to the best system advised by the local agricultural department, and where the results of research work could be concentrated in practice and demonstrated to growers under cultivators' conditions with the improved type or types of cotton best suited to each tract was recommended. The curtailment of acreage in India as a means of raising the price of cotton was considered to be of doubtful advantage.

The Committee approved of the recommendation of the Technological Research Sub-Committee for the purchase of a pilot plant for determining the cost of production of chemical cotton from linters, waste and cheap cotton. Sanction was also provisionally accorded to a scheme for carrying out investigations at the Technological Laboratory for improving the ginning of Indian cottons involving an estimated non-recurring expenditure of Rs. 24,500 and a recurring charge of Rs. 4,600 per annum.

A new cotton breeding scheme for the production of long staple cotton for cultivation in Sind at a total cost of Rs. 2,28,700 over a period of 5 years was also provisionally sanctioned.

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Botanical Society of Bengal.—The third annual meeting of the Society was held on February 25 at the Botanical Laboratory, Calcutta. Prof. S. C. Mahalanobis, President of the Society, took the Chair.

A Botanical Exhibition and Conversazionne had been organised.

The following were elected Office-bearers for the coming year:—*President*: Prof. S. C. Mahalanobis; *Vice-Presidents*: Prof. S. P. Agharkar, Prof. S. C. Banerji, Dr. K. P. Biswas, Prof. S. R. Bose; *Hon. Treasurer*: Dr. S. R. Sen Gupta; *Hon. Auditors*: Mr. P. K. Bose, Dr. A. N. Mitra; *Hon. Secretaries*: Dr. J. C. Sen Gupta and Mr. S. N. Banerji.

A resolution requesting the Government of Bengal to reprint Prain's *Bengal Plants* was adopted.

Lt.-Col. Chopra, I.M.S., delivered an address on the "Role of Botany in Pharmaceutical Medicine".

* * *

The All-India Institute of Hygiene and Public Health.—The Annual Report of the above Institution for the year 1937 which we

received a few weeks ago, is an interesting and valuable document, portraying its activities in the several fields of public health and research covered by the Institution. During the four years of its existence, the Institute has produced four batches of diplomats in public health, most of whom have found ready employment in State service.

Research of a fundamental character on cholera vibrios has been carried out by Dr. Linton and his colleagues; fresh light has been thrown on the ætiology of epidemic dropsy. Black water fever therapy is being successfully developed; this should "inspire confidence amongst those who are destined to extend the bounds of human civilisation into tropical jungles".

Investigation of about 900 maternal deaths in Calcutta revealed that maternity need not be attended with any risk, if the expectant mother is carefully looked after and trained midwives are in attendance. Most of the Public Health problems are connected with the economic prosperity of the community and the effective adoption of the results of research persued at the Institute, will entail the expenditure of large sums of money, which the government should be prepared to provide if the community should ever reap the benefits of these researches.

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Statistical Testing of Business-Cycle Theories.—Volume I. A Method and its Application to Investment Activity, by J. Tinbergen. The Economic Intelligence Service of the League of Nations has just published a Volume entitled "Statistical Testing of Business-Cycle Theories —A Method and its Application to Investment Activity," by J. Tinbergen.[1] According to a recent note issued from the Information Section of the League of Nations, this is the first instalment of a short series of publications to follow up Professor Gottfried von Haberler's scholarly work, "Prosperity and Depression," which was published by the Economic Intelligence Service in 1937. In that book Professor von Haberler, who is now at Harvard University, examined the different existing theories concerning the nature of what is currently termed the trade cycle, with a view to ascertaining what they had in common, the points at which differences arose, and in so far as possible the causes of those differences. Its publication constituted the completion of the first stage of an enquiry into the nature and causes of the trade cycle that had been begun some years earlier. The second stage was to consist of an attempt to confront those theories with the historical facts, to subject them, in so far as those facts can be quantitatively expressed, to statistical analysis, or, in so far as they cannot be so expressed, to compare them with the recounted records of the past.

The Volume which has just been published has been prepared by Professor J. Tinbergen, who was seconded for this purpose from the Central Statistical Bureau of the Netherlands. It forms an introduction to the work which has since been begun and which is concerned with the statistical testing of the assumptions and propositions that are essential to the main business-cycle theories. The primary object of the Volume is to explain the method which, subject to any suggestions that may be received, it is proposed to employ for the statistical testing of trade cycle theories. The description of the method known as multiple correlation analysis is followed by three examples of its application to economic phenomena. These examples relate to fluctuations in total investment, residential building and net investment in railway rolling stock. The results obtained in the elaboration of these three examples, as the Director of the Economic Intelligence Service of the League of Nations remarks in a preface, must prove of interest to students of the trade cycle. They are, however, only incidental to the primary objects of M. Tinbergen's work, which are to explain the system of statistical analysis employed and to arouse discussion concerning it that may prove of value in the execution of the work.

* * *

League of Nations: Health Organisation.—Dr. L. W. Rajchman, Director of the Health Section since its inception in 1921, resigned his office on January 31st. Dr. R. Gautier has been placed temporarily in charge of the section.

On the recommendation of the Bogotá Pan-American Sanitary Conference, the Bacteriological Institute of Buenos Aires, has been recognised as the centre for the distribution of international biological standards on behalf of the Health Organisation, to the central laboratories of South American Countries. Uptil now this was being done by the National Institute for Medical Research, London, and the State Serum Institute, Copenhagen.

* * *

Medicinal Plants in Himalayas.—Samples of valuable commercial medicinal plants from Kashmir Hills have recently been acquired for exhibition in the Industrial Section of the Indian Museum (Botanical Survey of India). These include, *Atropa Belladona*, which grows in the Himalayan ranges at altitudes of 6,000–12,000 feet; Indian Rhubarb, *Rheum emodi* growing wild in various parts of Nepal and Sikkim at altitudes of 4,000–12,000 feet; *Podophyllum emodi* or 'Papra', a small herbaceous plant growing wild from Sikkim Himalayas to N.W. Frontier; *Artemisia maritima*, the source of the valuable drug Santonin, found growing in Kurrum valley and in Kashmir; *Hyoscyamus niger* reported as growing wild in Kashmir Hills and recently brought under cultivation, contains the required percentage of alkaloid; *Valeriana Wallichii* grows wild in the mountain ranges extending from Kashmir to Bhutan at altitudes ranging from 4,000 to 12,000 feet; *Digitalis purpurea*, commonly known as foxglove, extensively cultivated in Darjeeling and Kashmir Hills; *Juniperus communis* and *J. macropoda*, the oil from the berries of which, is of importance in pharmaceutical trade, found in plenty in the western Himalayas; *Plantago ovata* or 'Isabghul' which grows in lower hills as well as in Punjab and Sind plains; *Colchi-*

[1] League of Nations, Ser. L.o.N.P., 1938, II, A. 23, 164 pages. Price: 3/6 *d.*: $0·90.

cum luteum extensively found in the Western temperate Himalayas, forming a good substitute for the official drug, the corms of *Colchicum autumnale* not reported as yet from any part of India; and *Aconitum chasmanthum*, which grows abundantly in Kashmir, regarded as a good substitute for the imported drug obtained from *Aconitum napellus*.

* * *

Recent Advances in Insect Embryology.—At the ordinary monthly meeting of the *Royal Asiatic Society of Bengal*, Calcutta, held on Monday, April 3, Dr. M. L. Roonwal presented a paper on insect embryology. The first part of the paper is devoted to a brief historical sketch of the development of insect embryology from early times. "This is followed by an account of some of the recent advances on the subject, the more important items dealt with being: the theory of multi-phased gastrulation; the 7-segmental nature of the insect head; the function of the pleuropodia; the mechanism of blastokinesis; the classification of insectan genital cells; and finally, the origin of some of the body sclerites, *viz.*, the labium and the pleuron. Some embryological problems whose study is likely to give fruitful results are described. A complete and classified bibliography of insect embryology is appended."

* * *

The Detection of Toxic Gases in Industry: Nitrous Fumes.—The detection of nitrous fumes is the subject of a further leaflet issued by the Department of Scientific and Industrial Research in the series dealing with the detection of poisonous gases produced in industrial processes ("Methods for the Detection of Toxic Gases in Industry, Leaflet No. 5, Nitrous Fumes" published H.M. Stationery Office, 3*d.* net).

The situations in which nitrous fumes may be encountered in dangerous concentrations include ammonium nitrate works, celluloid works, dyestuffs works, explosives works, nitric acid works, nitro-cellulose paint, lacquer and leather cloth works, photographic film works, sulphuric acid works (chamber process).

They are also encountered in electro-plating, engraving, metal cleaning and photogravure processes, and are formed during oxy-acetylene welding, particularly when an oxy-acetylene flame plays on cold steel in a confined space. They have caused fatalities during the heat treatment of metals in molten nitrates.

Nitrous fumes, the leaflet states, are extremely dangerous on account of their insidious character. There may be, and generally are, no immediate effects and, therefore, it is impossible to foretell the serious consequences that may result from the inhalation of these fumes. A workman, unaware that he has inhaled the fumes, continues at work, often remaining well until after he has returned home. Some hours later he becomes restless with a dry cough and shortness of breath. These symptoms increase, accompanied by a frothy sputum tinged with blood. If appropriate treatment is not applied, death follows from œdema (waterlogging) of the lungs.

Concentrations stronger than 1 in 10,000 are frequently fatal if breathed for more than a few minutes. It is, therefore, most important to note that a concentration which is dangerous to inhale for even a short time may be hardly noticeable, because no disagreeable symptoms may be produced. For this reason any atmosphere in which nitrous fumes are noticeable either by smell, irritation, or colour, should be regarded as dangerous.

The chemical test described in the leaflet is sufficiently sensitive to be readily capable of detecting a concentration of 1 part in 100,000.

The standard method of test which has been developed depends on the Griess-Ilosvay reaction. It is carried out by drawing the atmosphere under test by means of a hand pump through a tube containing the reagent (a mixed solution of α-naphthylamine and sulphanilic acid in acetic acid) until a rose-pink colour of standard depth is reached. From the number of strokes of the pump required to produce the standard colour, the concentration of nitrous fumes present can be obtained by reference to the table given in the leaflet. The leaflet contains detailed instructions for carrying out the test and for the preparation of the standard coloured solution required.

* * *

A Summary of the World Literature and a Critical Survey of the Mechanical Tests employed in testing Bituminous Road Materials is presented in a report recently issued by H.M. Stationery Office (the Mechanical Testing of Bituminous Road Materials, Special Report No. 1). As the intensive application of scientific methods to road research is a relatively recent development, engineers and surveyors will find this volume of great interest as a guide to the manner in which the mechanical testing of bituminous materials has been developed up to the present time.

It includes a bibliography of 137 references.

* * *

Prof. K. S. Krishnan, Mahendralal Sircar Professor of Physics, Indian Association for the Cultivation of Science, Calcutta, has been invited to present a paper on 'the application of magnetism to the study of crystallised media and molecular symmetry' at the Study Meeting on "Magnetism" organised by the *Institute of International Co-operation* in collaboration with the *Service Central de la recherche scientifique de France*. The meeting will be held at Strasbourg during May 21–25; the subjects will be discussed under the following heads: (1) Paramagnetism; (2) Ferromagnetism; and (3) Magneto-optics. *The International Institute of Intellectual Co-operation* has so far arranged four study meetings. The last meeting on "Fundamental Principles and Methods of the Mathematical Sciences", was held at Zurich in December 1938.

Professor Krishnan has also received an invitation to take part in the meeting of the Deutschen Bunsen-Gesellschaft to be convened at Danzig from 18–20 May to discuss problems in "Magnetochemie".

Professor Krishnan will be sailing from Bombay on April 29, and will return to India early in July.

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The Willam Prize for 1938 has been awarded by the Council of the Iron and Steel

Institute, London, to **Mr. D. V. Krishna Rao**, Iron and Steel Works, Bhadravati. This award is made to the author of a paper of a "practical character judged by the Council to be the best paper of that character presented to the Institute and accepted for publication at the Annual or Autumn meeting each year". Mr. Rao's paper which has received the award is entitled "The New Steel Plant of the Mysore Iron and Steel Works, Bhadravati, India". The paper gives a brief account of the new basic open-hearth furnace installed at Bhadravati in great detail. The principal constructional features, the leading dimensions of the furnace and the various improvements effected in the refractory lining are given. Full details of the producer-gas plant, valves, ladles and ingot moulds are also furnished. The method of teeming, rimming and killed steels is described in detail. The special procedure adopted when teeming killed steels is claimed to give very sound ingots and results in a very small percentage of rejections at the mills. A brief description of the reheating furnace and the rolling mills attached to the steel plant, together with the principal operating features and the extent of the rolling programme, completes the paper.

The value of the award is £100.

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Journal of Endocrinology.—A new journal devoted to the publication of communications which "advance knowledge concerning the internally secreting glands, the mode of their actions, and the disorders of their functions", will be published under the Editorship of Prof. E. C. Dodds, by the Oxford University Press. The Journal will be published quarterly in the first instance, in the months of January, April, July and October. The first issue is expected to appear this month.

Before deciding on the publication of this new journal, the members of the promoting committee consulted the Editorial Boards of a large number of British Journals, who, without exception, favoured the foundation of such a journal. The subscription rate for each volume will be 30*sh.* Papers intended for publication should be submitted to the Editors of the Journal, Courtauld Institute of Biochemistry, Middlesex Hospital, Mortimer Street, London, W.1.

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Andhra University.—Dr. C. R. Reddy has been re-elected Vice-Chancellor of the Andhra University for a further term of 3 years.

The Academic Council of the Andhra University has approved the proposal of the Syndicate to provide instruction in courses leading to M.Sc. degree in Applied Physics. The course will be opened in the Jeypore Vikrama Deo College of Science and Technology, from July 1939.

The Senate unanimously approved the proposal of the Syndicate that "the Honorary Degree of Doctor of Science, D.Sc., be conferred on Sonti Kamesam, M.E. (Hons.), M.I.E., in recognition of his distinguished researches in Timber Technology and Forest Produce generally and their economic utilisation".

The Medical Council of India, at its meeting held on April 3–4, decided *inter alia* to recognise the M.B.B.S. degree of the Andhra University.

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University of Mysore.—I. LECTURES: The following lectures were delivered under the scheme of Extension Lectures during the month:—(1) Mr. P. Kodanda Rao, M.A., Servants of India Society, Poona, on "A View of Civilization" in English at Bangalore. (2) Mr. V. Venkatachar, M.A., B.com., Assistant Director (Commerce) and Secretary, Board of Industries and Commerce, Bangalore, on "The Foreign Trade of Mysore" in Kannada, at Davangere and Shimoga. (3) Mr. D. S. Mallappa, M.L.C., Merchant, ex-President, Tumkur District Board, and Director of the Bank of Mysore, Ltd., Tiptur, on "Social Legislation" in Kannada, at Bangalore and Mysore. II. INTER-UNIVERSITY BOARD: The Vice-Chancellor has been elected Chairman of the Inter-University Board for the year 1939–40.

Announcements

Sugar Technologists' Association of India.—The next convention of the Association will be held sometime either in September or October, 1939.

Those desirous of communicating papers for the convention are requested to get into touch with the Secretary, Sugar Technologists' Association, Cawnpore. Papers should reach the Secretary before the end of June.

Papers dealing with original researches, new designs, calculations and new application of known processes and equipment are naturally those which will receive first consideration. But besides these, papers on subjects of technical and general interest to the industry will also be welcomed. Some of the subjects which may be specially mentioned as suitable for this purpose are cane agriculture, cane diseases and pests, fixation of sugarcane prices, sugar manufacturing processes, sugar engineering, utilization of bye-products, fuel consumption, chemical control, and fiscal and economic aspects of the industry.

Papers dealing with the engineering side of the Industry are specially requested and it is hoped that gentlemen connected with the designing, manufacture, erection and maintenance of machinery and equipment for the sugar industry will come forward with papers which will focus attention on recent developments in this important section of the Industry.

13th International Acetylene Congress.—Further details regarding the 13th International Congress of Acetylene, Oxy-Acetylene Welding and allied industries, are now available. The Congress will be held in Münich from October 2nd to 6th, 1939, under the protectorship of Prime Minister Field-Marshal-General Hermann Göring. The inaugural ceremony will be held on Monday October 2, in the banquet hall of the German Museum, Münich. Excursions have been arranged for the Münich October festivities, to the Eibsee and to the Zugspitze; a two-days' trip through the Alps to Innsbruck and Salzburg has also been organized. In connection with the Congress there will be a

Technical-Scientic exhibition covering the whole field of the Congress and subdivided into various sections.

All communications intended for being presented at the Congress must reach the Congress Office, Berlin-Friedenau, Bennigsenstrasse 25, on or before June 15th, 1939.

Imperial Mycological Conference.—The provisional programme of the Conference which will be held at the Imperial Mycological Institute, London, is now available. The Conference will be held from September 18th to 23rd.

The subjects for discussion will include: Quarantine in relation to plant diseases, biological methods of evaluating the efficiency of fungicides, virus diseases of economic plants, soil deficiency diseases, bacterial diseases of stone fruits in the Empire. Short summaries of papers offered should reach the Director, Imperial Mycological Institute, London, before the end of July.

The **Eighteenth International Congress of Anthropology and Prehistoric Archaeology** and the Eighth Session of the International Institute of Anthropology will be held at Istanbul, Turkey, from September 18–25, 1939. Communications regarding the Congress may be addressed to Prof. Muzaffer Göker, Dean of the Faculty of Languages, History and Geography, Ankara, Turkey, who is the General Secretary of the Congress.

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We acknowledge with thanks, receipt of the following:—

"Agriculture and Live-Stock in India," Vol. 9, Pt. 1.

"Journal of Agricultural Research," Vol. 57, No. 12 and Vol. 58, Nos. 1 and 2.

"Agricultural Gazette of New South Wales," Vol. 50, Part II.

"The Philippine Agriculturist," Vol. 27, Nos. 9 and 10.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, Nos. 1 and 2.

"Nagpur Agricultural College Magazine," Vol. 13, No. 3.

"Indian Journal of Agricultural Science," Vol. 9, Part I.

"L'Agricoltura Coloniale," Vol. 33, No. 1.

"Journal of the Royal Society of Arts," Vol. 87, Nos. 4496–4504.

"Biochemical Journal," Vol. 33, Nos. 1 and 2.

"Journal of the Institute of Brewing," Vol. 45, No. 3.

"Berichte der deutschen Chemischen gesellschaft," Vol. 72, No. 2.

"The Calcutta University Journal," Vol. 1, No. 2.

"Chemical Age," Vol. 40, Nos. 1022–29.

"Comptes Rendus (Doklady)," Vol. 22, Nos. 1 and 2.

"Journal of Chemical Physics," Vol. 7, Nos. 1, 2 and 3.

"Journal of the Indian Chemical Society," Vol. 15, Nos. 11, 12 and Vol. 16, No. 1.

"Journal de Chimie Physique," Vol. 35, No. 12 and Vol. 36, No. 1.

"Experiment Station Record," Vol. 80, No. 1.

"Transactions of the Faraday Society," Vol. 35, Nos. 214 and 215.

"Indian Forester," Vol. 65, Nos. 2, 3 and 4.

"Indian Forest Records," Vol. 1, No. 3 (Botany) and Vol. 5, No. 1 (Entomology).

"Forschungen und Fortschritte," Vol. 15, Nos. 4–9.

"Genetics," Vol. 24, No. 1.

"Calcutta Medical Journal," Vol. 35, Nos. 3 and 4.

"American Museum of Natural History," Vol. 43, Nos. 2 and 3.

"Mathematics Student," Vol. 6, No. 3.

"Bulletin of the American Meteorological Society," Vol. 19, No. 10.

"Journal of Nutrition," Vol. 17, No. 2.

"Nature," Vol. 143, Nos. 3613–20.

"Indian Journal of Physics," Vol. 12, Part II.

"Canadian Journal of Research," Vol. 16, No. 12.

"Proceedings of the Royal Society of Netherlands," Vol. 41, No. 9.

"Proceedings of the Royal Irish Academy," Vol. 45, Section A, Nos. 1, 2, 3 and 4 and Vol. 45, Section B, Nos. 2, 3, 5 and 6 and Index to Vol. 44.

"Journal of Research (National Bureau of Standards)," Vol. 21, No. 4.

"Lingnan Science Journal," Vol. 18, No. 1.

"Sky", Vol. 3, Nos. 4 and 5.

"Indian Trade Journal," Vol. 132, Nos. 1703–11.

Catalogues

"Cambridge Spring Books," 1939 (Cambridge University Press, London).

"New Books, Spring," 1939 (Edward Arnold & Co., London).

"Varlag von Gustav Fischer in Jena," No. 1 (February 1939).

"Catalogo Generale delle Publicazioni," 1907–1938 (Instituto Agricolo Coliniale Italiano).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

March 1939. SECTION A.—S. S. PILLAI: *On* v(k). P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part VII. Position of the glucose residue in Gossypitrin.*—The constitution of Gossypitrin has been established as the 7-glucoside of the flavonol Gossypetin. S. RAMACHANDRA RAO AND S. ARAVAMUTHACHARI: *The Magnetic Susceptibility of Mercury and of some Dilute Alkali Amalgams.*—From the observed susceptibility value of −33·3 for mercury in the liquid state, it is suggested that the mercury atoms exist in the liquid as divalent ions Hg^{++}. In the dilute amalgams, Li caused an increase in diamagnetic susceptibility and the other alkalis a decrease. It is suggested that the alkali atoms are dispersed as single atoms at low concentrations, and double atoms at relatively larger concentrations. S. CHOWLA: *A Definite Integral.* L. SIBAIYA AND T. S. SUBBARAYA: *Zeeman Effect of Hyperfine Structure in Intermediate Fields.*—The green line Hg I λ5461A has been studied at field strengths up to 4000 gauss. The results show a good agreement with theory both as regards separations as well as intensities. L. SIBAIYA: *On the Self-Reversal of Spectral Lines.* S. BHAGAVANTAM AND T. VENKATARAYUDU: *Raman Effect in Relation to Crystal Structure.*—A theory of the normal oscillations of crystal lattices is presented and the normal modes of oscillations of some typical crystal lattices are worked out. S. RANGASWAMI AND T. R. SESHADRI: *Synthetic Experiments in the Benzo-pyrone series. Part I. Synthesis of Karanjin-α-Carboxylic Acid.* N. JAYARAMAN: *The Cause of Colour of the Blue Quartzes of the Charnockites of South India and of the Champion Gneiss and other Related Rocks of Mysore.* M. DE HEMPTINNE AND C. MANNEBACK: *Raman Effect and the Potential Function of the Ethylene Molecule.*

March 1939. SECTION B.—D. V. BAL AND S. K. MISRA: *A Study of the effect of different types of rations on the quality of milk, milk yield and the general condition of milch buffaloes.*—Cotton seed significantly affects the characteristics of the butter fat by increasing its melting point, and by lowering the proportion of the volatile water-soluble and insoluble fatty acids contained in it. V. S. ABHYANKAR, W. V. KOTASTANE AND N. NARAYANA: *The Proteins of Bajri* (Pennisetum typhoideum).—The nitrogen distribution of prolamin and total globulin and its two fractions globulin-A and globulin-B have been studied and their essential amino acids determined. B. N. SINGH AND M. L. MEHTA: *Studies on Physico-Chemical relations of Soil and Water—I. Water retentive force of soil as influenced by chemical fertilisers.*—The effects of ammonium sulphate (N), potassium sulphate (K) and double superphosphate (P), singly and in combinations (total 8 treatments) on the water retentive force of the soil at different moisture contents have been recorded. C. SURYAPRAKASA RAO: *The Myxophyceæ of the Bihar Province, India—I.*—Twenty-five forms have been recorded and out of these, three varieties and three forms are new.

Indian Association for the Cultivation of Science: (*Proceedings*, 21, *Part* 5)

November 1938.—P. KOTESWARAM: *Dissociation in sulphuric acid with temperature.* SUDHENDU BASU AND A. T. MAITRA: *Thermal coefficient of Rocksalt by X-ray reflection.* MOHINIMOHAN GHOSH: *Dynamics of the pianoforte String and the Hammer, Part I (Hard hammer).* S. K. MUKERJI: *On the Hyper-fine structure and analysis of some complex Lines in the first spark spectrum of arsenic in the Ultra-violet Region.* SARAJUPRASAD GHOSH: *Dispersion, Absorption and Polarisation Curves for Radio-wave propagation in the Ionosphere.* JAGANNATH GUPTA: *The origin of low frequency Raman lines in Solids.* J. N. BHAR: *Stratification of the Ionosphere.*

Indian Chemical Society:

December 1938.—A MUKHERJI: *The Vitamin B Complex in Toxic Conditions.* K. MITRA: *Nutrition Studies in Bihar, Part II. Chemical Composition of some Local Edibles.* T. N. MEHTA AND V. B. THOSAR: *The Reaction of some Aromatic Diamines with Ethyl Malonate.* PRIYADARANJAN RAY AND HARIBOLA SAHA: *Complex Compounds of Biguanides with Tervalent Metals. Part V. Thiocyanates of Chromium Biguanides.* N. N. CHATTERJEE AND GIRINDRA NATH BARPUJARI: *Spiro-compounds. Part V. The formation and transformation of Spiro-compounds from* 3- *and* 2-*Methylcyclo hexanones.* B. L. MANJUNATH AND M. S. SHANKARA RAO: *Chemical Examination of* Bragantia wallichii (*Lour.*). G. V. JADHAV AND D. R. SUKHTANKAR: *Interaction of Sulphuryl Chloride with Arylamides of Aromatic Acids. Part I.* B. L. MANJUNATH AND M. S. SHANKARA RAO: *Note on the Occurrence of Behenic Acid in the Oil from the Seeds of* Pongamia glabra, *Vent.*

January 1939.—VISWANATH SHARMA AND SALIMUZZAMAN SIDDIQUI: *The constituents of* Didymocarpus Pedicellata. *Part II. Comparative studies in the Constitution of Pedicin, iso-Pedicin, Pedicinin and Pedicellin.* H. KRALL: *The Tautomerism of Nitrous acid.* M. K. INDRA: *Variation of the cataphoretic velocity of silver halides in presence of different dyestuffs.* MAHAN SINGH: *Studies on Rotatory power and chemical constitution. Part IV.* BALAWANT SINGH AND SOHAN SINGH: *Potentiometric studies in oxidation-reduction reactions. Part IV. Oxidation with potassium chlorate.* KUNJ BEHARI LAL AND HANS KRALL: *The Phenylthiocarbamides. A contribution to the study of the Triad -N.C.S-. Part VIII. The Chemistry of Hector's Base and attempts towards its synthesis.* P. C. MITTER AND SHYAMAKANTA DE: *Studies in γ-Ketonic acids. Part I.* H. S. JOIS, A. KUPPASAMI AND B. L. MANJUNATH: *Isomerisation of Benzylidene Derivatives. Part I.* BAIDYANATH GHOSH: *Studies on the changes of Blood-lipoids of Normally fed and Vitamin C-deficient Guinea-pigs.*

444-39.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc. for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore